EDITORIAL

A GREAT deal of attention has been given lately to the matter of stereo broadcasting. The research has a certain amount of commercial incentive but it also poses an interesting challenge to the generation of engineers, which has substantially solved the problems of stereo sound recording.

Stereo broadcasting has been carried on, overseas and locally, by using separate transmitters and receivers, but I don't think there is any real future in this method. Quite apart from the wastage of "ether space," it requires a double tuning operation and represents a complication, which the average listener just won't be bothered with. If stereo receivers are to find wide acceptance, they must be no more complex in use than the conventional variety as, of course, is the case with stereo records and tapes.

Various means have been suggested for superimposing stereo information on broadcast band transmissions, while still allowing conventional AM receivers to reproduce a composite signal. Out of these may come an agreed standard procedure but that will not automatically ensure its general acceptance. At the receiving end, we will still be up against the all-too-familiar problems of bandwidth and interference so that, unless a ready solution is found, the overall results may not be worth the trouble.

If we are to have stereo broadcasting, it would seem much the better plan, technically, to mate it with frequency modulation on the regular VHF, FM band. It should be feasible to devise a standard method of transmission which will supply a compatible signal for mono or stereo tuners and which will make the full range of audio frequencies more readily available.

There has been a good deal of speculation in the U.S., in recent months, about the future of stereo in relation to present AM, FM and TV services. It looks, at the moment, as if FM will gain priority in the derivation and establishment of standards for compatible stereo transmissions and it may give FM a much-needed "shot in the arm."

In Australia, FM broadcasting has never got beyond the experimental P.M.G. transmissions. But who knows? A buying public which is gradually becoming stereo and hi-fi conscious may just go for FM, if it is exploited as the companion medium.

W. N. Williams

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RADIO ★★
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Vol. 22 No. 7

SUBSCRIPTION RATES
C'wealth, Fiji, N. Guinea, £1/15/- p.a.
United Kingdom and N.Z., £A2 p.a.
British Dominions — — £A2 p.a.
Foreign — — — — £A2/10/- p.a.

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OUR COVER PICTURE

The demand for electricity grows almost daily and the N.S.W. Electricity Commission has undertaken a vigorous program to ensure that this demand will continue to be met. Here two workmen are seen fitting air break switches at another new sub-station recently erected at Port Hacking.

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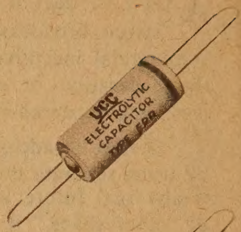
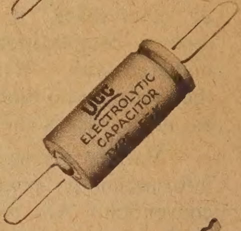
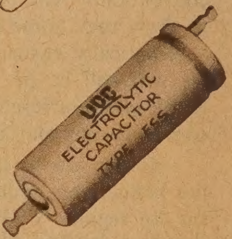






TECHNICAL DATA

CAPACITANCE TOLERANCE:

0 to 100 volts — 10% + 100%   101 volts and over — 10% + 50%

POWER FACTOR:

0 to 100 volts inclusive 30% at 100 cycles per second.
101 volts and over 15% at 100 cycles per second.

WORKING VOLTAGE:

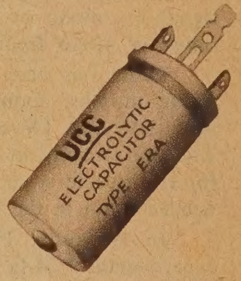
This is the sum of the D.C. voltage and A.C. ripple voltage which can be applied to the capacitor for continuous operation.

PEAK RIPPLE VOLTAGE:

Is the instantaneous value of A.C. voltage across the capacitor caused by the A.C. component. This voltage, as a rule, should not exceed 6% of the rated peak working voltage at 100 cycles per second or 12% of the rated peak working voltage at 50 cycles per second.

PEAK OR SURGE VOLTAGE:

Is the maximum voltage the capacitor will withstand without damage when connected in series with the resistor having a value of $\frac{20,000}{C}$ ohms for 30 seconds: the voltage is measured across the resistor/capacitor combination.



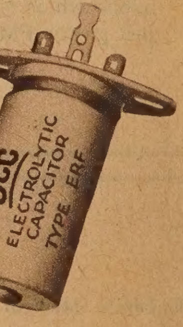
LEAKAGE CURRENT:

All ER and ES type electrolytic capacitors have a finite leakage current. When first connected to a power source the charging current is high, but rapidly drops to a normal value as given by the formula:

$$I = \left(\frac{CV}{10} + 100\right)\ \mu A,$$

C = Capacity in microfarads.
V = Working voltage.
I = Current in microamperes.

It should be noted that the leakage current given by this formula is the maximum acceptable for satisfactory performance and is normally less than half this value. All readings should be taken at 25°C. after applying the working voltage for five minutes; plus one minute for every month of shelf-storage.



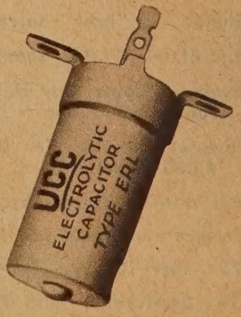
TEMPERATURE:

The effect of temperature is important and it is closely related to and affects all characteristics. The ratings of type ER and ES electrolytic capacitors are based on a maximum temperature of 85°C. The temperature co-efficients of capacity and leakage current are positive whilst that of the power factor is negative.

SHELF-LIFE:

Idle storage has a deteriorating effect on the anode film and should electrolytic capacitors be stored for any length of time they should be re-aged. This is most easily accomplished by applying 90% of the rated voltage to the capacitor in series with a 10,000 ohm heavy duty resistor.

Initially due to a high leakage current the voltage applied to the capacitor will be low, gradually increasing as the current decreases. When the leakage current reaches the rated value the capacitor is ready for use.



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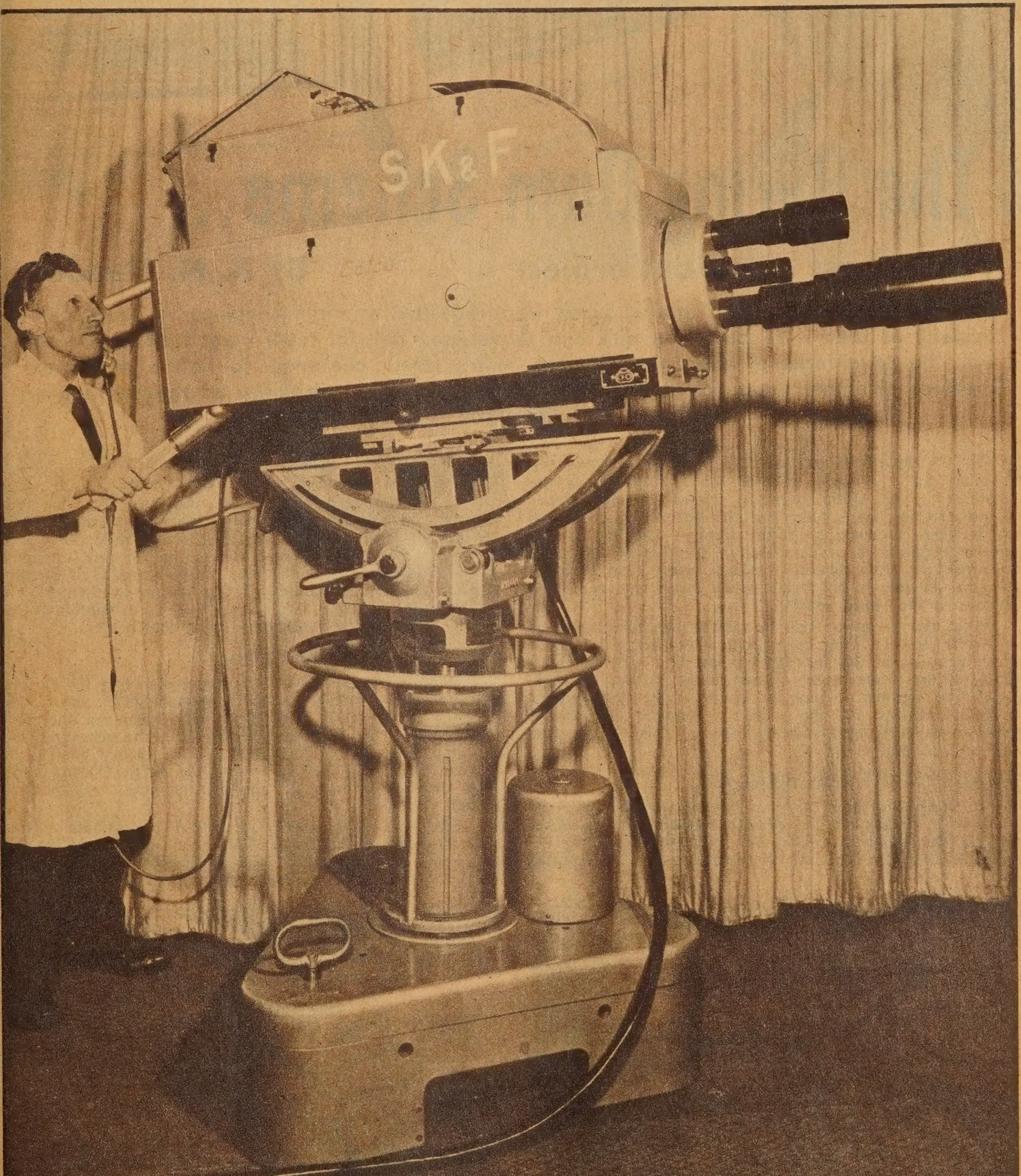
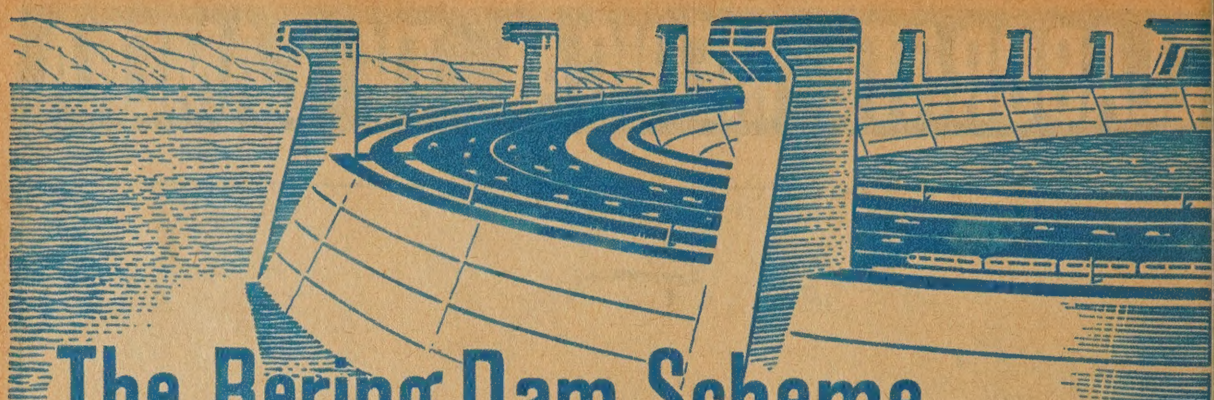


In striking contrast to the tiny one-man TV camera we described in the August issue, this monster must be among the world's largest. But there's a good reason for its size: It is one of the latest Marconi 3-Tube Image Orthicon Colour Cameras, and which the designers claim has many advantages over previous colour cameras. As well as studio use, it is finding extensive application in closed circuit systems, especially for medicine and surgery. This particular camera is part of a complete medical demonstration unit ordered by Smith Kline & French Laboratories Ltd., and at present on a tour of major Australian hospitals. See story page 9.



The Bering Dam Scheme...

Man's most ambitious project

By R. N. Hadden

In their day, the Suez and Panama canels were regarded as mighty engineering feats, particularly as they were built in a pick and shovel era. But, for sheer magnitude, and even with the advantages of modern equipment, man's latest challenge to nature makes all previous attempts seem puny. Yet it is not beyond the capabilities of modern engineering skill.

RUSSIAN engineers and weather men have drawn up plans for a fantastic scheme that would change the climate of all the Arctic countries. If their scheme is ever put into practice, lands which are now barren, frozen wastes may in years to come be fertile farms. The key to this amazing proposal is a dam across the Bering Strait. A dam stretching from Siberia to Alaska, more than 50 miles in length. A dam so big that it would dwarf any man-made structure in the world today.

What the Russians hope to achieve is the warming of the Arctic Ocean. They claim that when they have raised the temperature of this inhospitable sea, they will also have eliminated the prime cause of most of the Northern Hemisphere's bad weather. Once the cause of the bad weather has been removed and the winters are milder, millions of square miles of frozen lands will thaw. This can then be used as farmland.

OCEANS EFFECT THE WEATHER

To understand how this vast scheme would work, it is necessary to understand the effect the oceans of the world have on the weather. Take, for example, two cities — Bordeaux and Montreal. Both these cities lie on roughly the same latitude. If other factors did not come into play, they should have more or less the same climate.

In actual fact, however, these cities have quite different climates, the average winter temperature in Montreal being 16 deg. of frost, whereas Bordeaux has a mild 50 deg. F average winter temperature. The reason for this difference is that Bordeaux lies in the path of the warm Gulf Stream, whereas the eastern shores of Canada are washed by the icy Labrador Current. Warm seas and warm winters go together, and conversely cold seas mean cold winters.

WARM SEAS—MILD CLIMATE

What is true for these two cities is also true for the rest of the world. When a country is surrounded by warm seas, or when the prevailing wind blows off a warm sea, the climate is mild. On the other hand, when the seas are cold the climate is cold. This, then, is the theory behind the Russian plan — if they can warm the Arctic Ocean, it follows that the climate of northern countries will become milder.

Fig. 1 shows the ocean currents of the Atlantic. Note how the warm Gulf Stream flows northward across the Atlantic and up the western coast of Europe. Wherever this

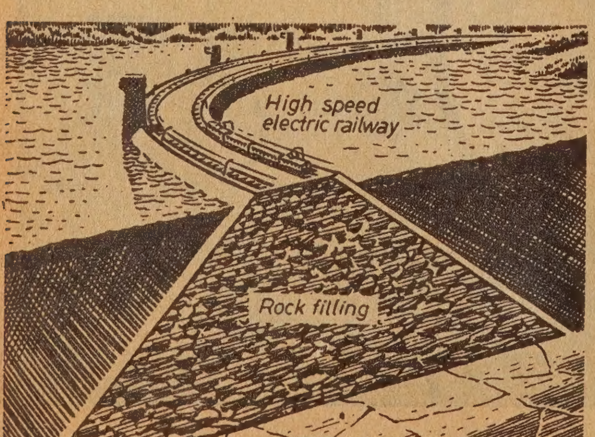


Fig. 2. The proposed mode of construction for the two 10 mile end sections of the dam where no pumps will be housed. A rock or "earth filled" wall will be erected, using material from the shore.

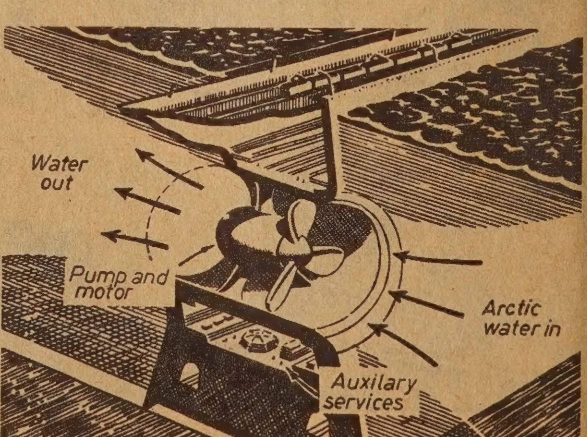


Fig. 3. By contrast, the centre section of the dam, housing the pumps, will be built from reinforced concrete. Each section will be prefabricated on shore and floated to the site

current exerts its influence the climate is much milder than other places in the same latitude, which are not so warmed.

Fig. 1 also shows how the Gulf Stream flows powerfully onward, not losing its strength until it reaches the latitude of Spitsbergen and Novaya Zembla. However, when it does reach the Arctic it is at last broken up. Here it is rather like trying to put water into a bottle which is already full — as much flows out as flows in. In the Arctic Ocean, as the Gulf Stream flows in on the eastern side, water flows out on the western side of Greenland. This "overflow" of water is known as the Labrador Current and, as might be expected, this is an icy current. It is this current which gives Canada its cold winters.

Another important thing to note from this map is that the Arctic Ocean itself has very few currents. In other words, it is a stagnant, icy sea, which stores up coldness, which in turn freezes the winds before they blast down on the northern countries. It is this situation which the Russians hope to change.

The Russian plan is to build a dam across the Bering Strait and to pump the cold water from the Arctic Ocean into the Pacific. They say that when they do this the Gulf Stream will not end its journey where it does, but will surge right across the Arctic and the North Pole and in its turn be pumped into the Pacific. In doing so, it will warm the whole Arctic Ocean and so eliminate the conditions which create the harsh weather. This, too, is shown in Fig. 1.

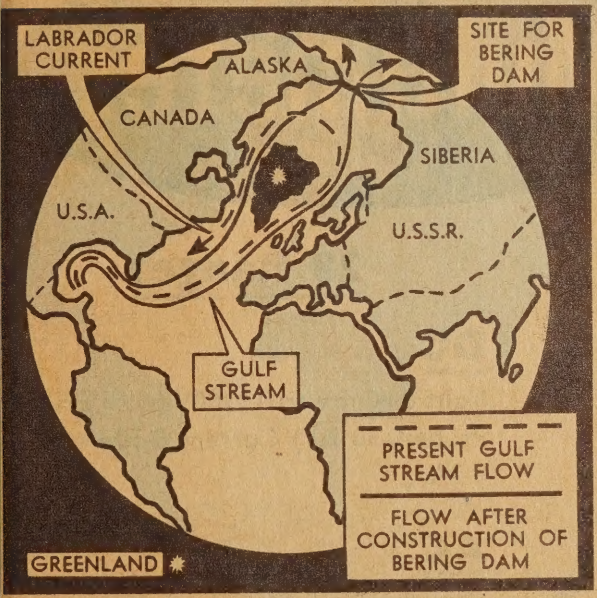


Fig. 1. This map shows the path of the warm Gulf Stream as it flows up the west coast of Europe and how it turns around in the region of the Bering Strait and becomes the icy current known as the Labrador Current.

There is no doubt that this scheme would benefit Europe, northern Canada and Siberia, but what will happen to the countries which will lie in the path of the new current from the Bering Dam? Will they be condemned to freeze as the icy waters from the Arctic are pumped out? A glance at the map of the Pacific will show that, in fact, the problem does not exist. As will be seen, the land on either side of the Strait falls back very quickly, giving free access to the Pacific Ocean. Therefore, the current from the Bering Dam would be quickly spread out and lost in the vastness of the ocean. For this reason the effect on the climate of the countries bordering the Pacific would be insignificent.

There are three main items which would have to be built to make the scheme a reality. They are the dam, the pumps and the power stations to supply electricity for the pumps. As yet no really firm plans have been drawn up for this project, but it is possible to predict certain broad outlines. There is no doubt that the engineering skill in the world today is sufficient to make this scheme quite practical.

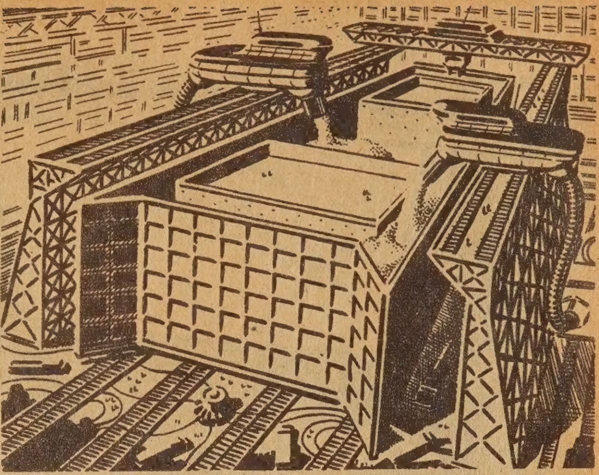


Fig. 4. A reinforced concrete section as it might appear during construction. It is lying on its side, a position also favoured for towing to its final position.

The dam would be the most massive part of the whole project, and the part which would probably set the greatest number of problems. It would not be conventional. Most dams have water on only one side, which means that they must be very strong to withstand the pressure. The Bering Dam on the other hand, would have water on both sides at more or less the same level. For this reason it would not have to withstand great hydraulic forces.

However, it would have to house the pumps, and if the scheme is to be really effective, they would have to have a capacity at least equal to the Gulf Stream. It follows, therefore, that the pumps would be very large, and there would be a great number of them. It is quite probable that three-quarters of the length of the dam would be required to house the pumps, and that the pumps themselves would be 40ft in diameter.

DETAILS OF DAM CONSTRUCTION

In view of the foregoing considerations it is probable that the dam would be designed in two parts. The 10 miles nearest to either shore would be an earth-filled dam as shown in Fig. 2. An earth-filled dam would have several advantages for these sections. The first is that material for building on would be readily available on either shore. Another is that it would be comparatively easy to build, as in the early stages the material would be loaded into barges and towed out to position, where it would be dumped. When the filling had reached the water surface the extra material required to finish the dam would be hauled out in giant trucks. When the dam was up to full height a facing of boulders would be laid to protect it from heavy seas.

While an earth-filled dam would be fairly easy to construct it would not be suitable for housing the pumps. For this reason the centre portion of the dam containing the pumps would be made from reinforced concrete. A sketch of the probable shape of this part of the dam is shown in Fig. 3.

In view of the difficulties which would be experienced in building the reinforced concrete part of the dam in the middle of the Strait under Arctic conditions, it has been

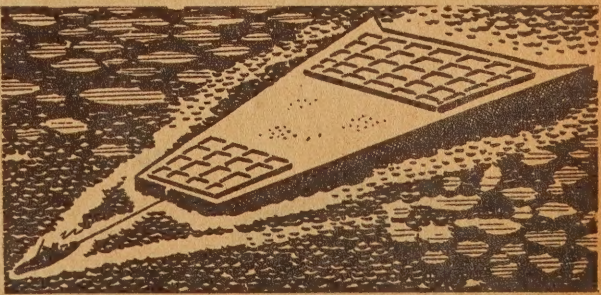
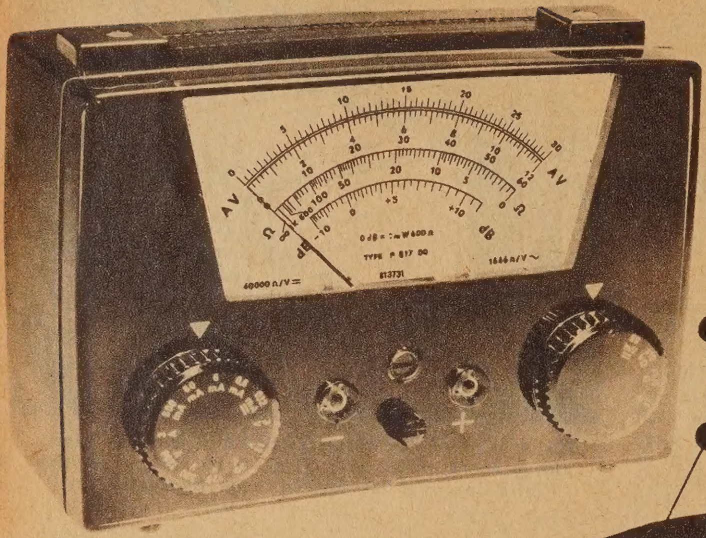


Fig. 5. After pouring, the huge concrete section will be towed to the site of the dam wall.



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uggested that it should be built in sections and floated out. igs. 4 to 7 show this would be done.

Fig. 4 shows how the dam section would be built on s side in a dry dock. An overhead crane would be used o set up the formers, which would be used over and over or many sections. The overhead crane would also be used o place the reinforcing bars, while pumps would be used o pour the concrete. When the section was complete all the penings would be covered over to make it watertight, and it ould then be launched.

When the section was afloat it would be taken in tow nd brought to the site, as shown in Fig. 5. On arrival at the ite the section would be partly flooded with water which would cause it to float the right way up as shown in Fig. . The section would then be positioned accurately and inally sunk.

When the section was sunk, the sharp feet at the bottom would cut into the mud until they reached bedrock. The nud between the feet would be pumped out and concrete would be pumped in to replace it. The inside of the section would then be pumped dry, the extra weight of the concrete between the feet preventing the section from refloating. The nside of the section would then be filled with concrete up o the level of the auxiliary services bay, as shown. All he finishing details of the inside of the section would then be completed, including the installation of the switch gear, ables, transformers, lubricating oil pumps, control room nd so on.

OVERHEAD GANTRY CRANE

When several sections had been completed internally, an overhead gantry crane would be erected. This crane would be used first of all to lower stop logs over the inlet and outlet openings of the pump. This would allow the temporary covers over these openings to be removed. The crane would then unload the giant pumps from ships and lower them into the body of the section where they would be installed as shown in Fig. 3.

The pump would come as a fully assembled unit and even when the whole scheme was in operation no maintenance would actually be done on site. If any repairs were required, the pumps would be shipped back as a unit to the mainland for overhaul.

To complete the dam, a high-speed twin-track railway and a roadway would be laid over the top of the dam. This would mean that for the first time in history all the major countries, with the exception of Australia, would be connected by land. It should even be possible to travel from Britain by land, as the Channel tunnel will probably have been completed.

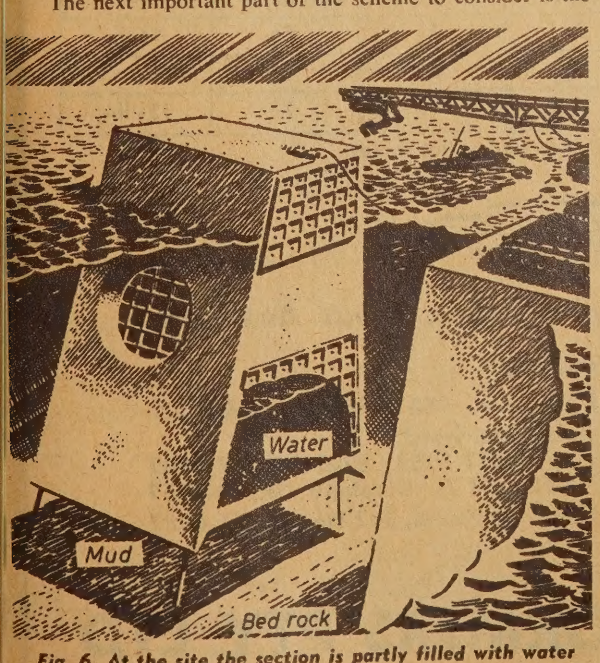

Fig. 6. At the site the section is partly filled with water to bring it to an upright position, then concreted into position and pumped dry.

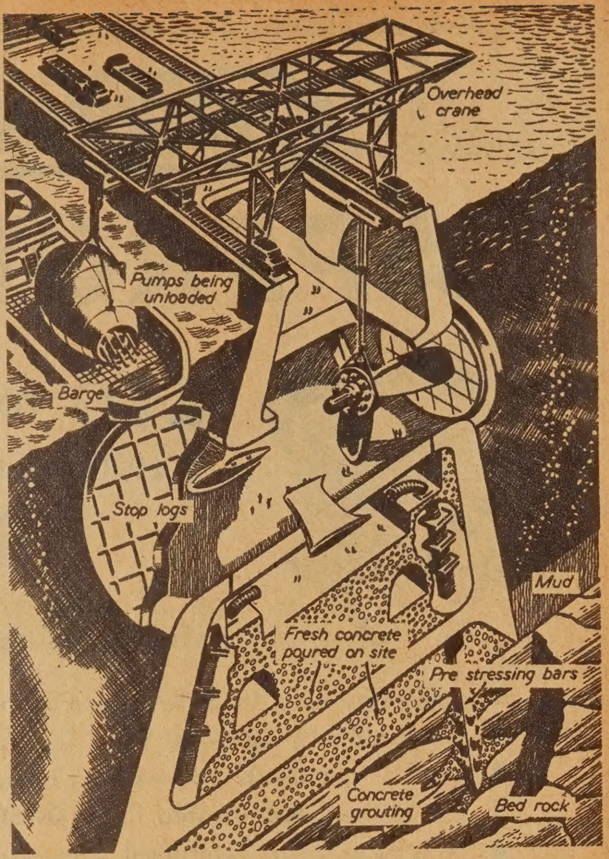

Fig. 7. The final step will be to fit the huge pumps, whose job it will be to change the ocean currents. In so doing they will change the climate of thousands of square miles of what is now barren wasteland.

The next important part of the scheme to consider is the pumps. These pumps would be unusual in several aspects. One unusual feature would be that they would not have to pump at great pressure. They would only have to take water from one side of the dam and push it out the other. However, they would have to handle tremendous quantities; their output would not be measured in gallons per minute, but in tons per second. The most suitable type of pump for this duty would be the axial flow design, which is very similar to a ship's propeller, and would be about 30ft in diameter.

The electric motors to drive these pumps would also be unusual, as they would be of the submerged type. This design would have the advantage of enabling a direct drive to be used. The motors would be giants, probably not less than 50,000 h.p. each. To prevent water getting into the windings and also to cool them, pressurised hydrogen would be circulated.

ATOMIC POWER FOR THE PUMPS

To provide power for the pumps would be an engineering feat in itself. It is almost certain that atomic power stations would be used. These power stations would probably be of the fast breeder type, as the indications are that these would be the most economical to run. The constant load requirements of the pumps would be a great advantage, as the power stations could run at constant load day in, day out.

So much, then, for the practical engineering side of the scheme. The only thing that stands in the way of its realisation is obtaining the agreement of all the countries concerned. This may be a much longer process than building the dam. The other question is who will pay for it? The estimated cost is £600,000,000. Probably, if the scheme goes ahead, Russia, Canada and the U.S.A. will bear the cost between them.

That, then, is the Bering Dam scheme. It is certainly fantastic, but no more so than sending a rocket around the moon. As one Russian engineer said, "When the cold war has thawed, we can set about thawing the Arctic."

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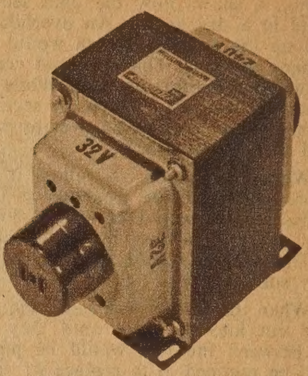

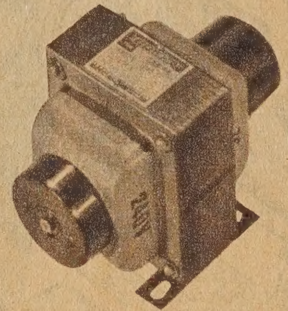

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COLOUR TV FOR AUST. HOSPITALS

Of all the jobs undertaken by TV, and colour TV in particular, that of medical instruction is one in which its unique qualities have been most dramatically demonstrated. A medical colour TV unit at present touring Australia has been enthusiastically praised by doctors who have seen it in operation. Here is a description of the equipment and its method of use.

Smith Kline & French Laboratories Ltd. London.
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MEDICAL COLOUR

The complete colour TV system is housed in this van, the interior of which is divided into two compartments and driver's cabin. The van weighs 8 tons fully loaded, 2 tons being accounted for by the TV equipment.

HOW to pass on the skill of an experienced surgeon to the students who must some day take his place has always presented a difficult problem. For obvious reasons the number who can be physically present alongside the operating table must be limited.

Even then there is a risk of their hampering the surgeon if all are to get a good view and, since this must not happen, a restricted view usually has to be accepted.

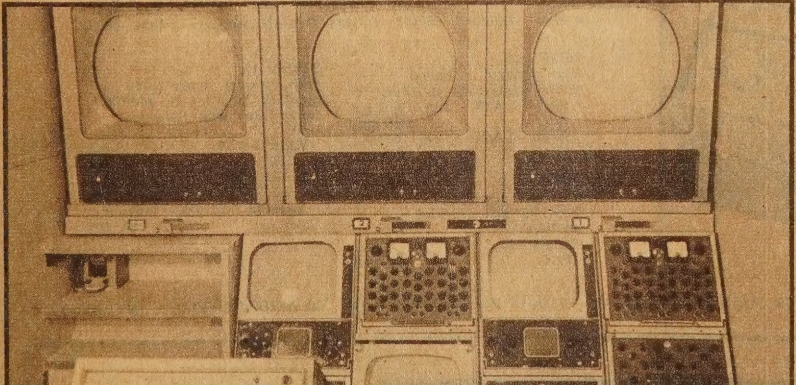
KEEPING PACE

Nor is the problem confined to students. Fully qualified doctors and surgeons are in continual need of instruction in order to keep pace with the rapid progress in modern medical science. And, where radically new techniques have to be demonstrated, the number who may wish to see a particular operation may run into hundreds.

There have been many attempts to solve this problem. Motion pictures, first in black and white and later in colour, have played a significant part in the the past and, regardless of what transpires in the future, will undoubtedly assume an important role for a long time to come.

But films have their limitations and it is seldom practical to record and replay an entire operation, meaning that the student is usually presented with an edited version which, while extremely useful, may give a false impression of time and other factors. On the other hand, a record which can be replayed over and over again will always have its place in the scheme of things.

The advent of TV was hailed as the best answer to the problem so far, and many experiments were made with early black and white systems. These undoubtedly offered a great deal, but the lack of colour was a serious limitation. A black and white image can show the mechanics of an operation but it cannot portray the all important colours which signify the difference between healthy and diseased tissue etc. In short, colour is vital.



The centre compartment of the van is the Control Room, shown here. In the top rack are three 21in colour monitors, one line and two camera monitors. Below them are picture and waveform monitors and camera control equipment.

So far, only a few hospitals in the U.S.A. have been able to afford permanent colour TV installations, and it may be some time before such installations become a regular feature of most hospitals. Realising this, the firm of Smith Kline and French Laboratories Ltd., London, pharmaceutical suppliers, decided to acquire a complete colour TV system which could be made available to medical conventions as a gesture of goodwill to the medical profession.

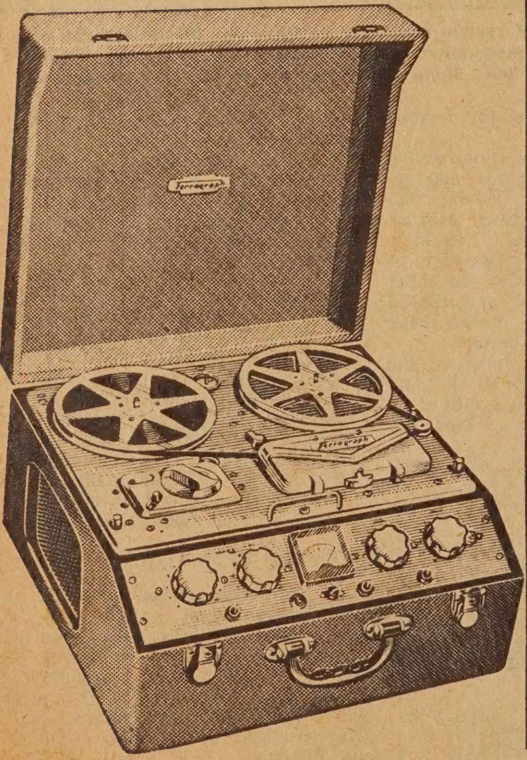
CONTINUOUS USE

An order was placed with the Marconi Company and the unit was delivered in June 1958. It was an immediate success and has been in almost continuous use ever since throughout the United Kingdom. Recently it was shipped to this country and has so far given demonstrations in Adelaide, Melbourne, and Brisbane. It is due in Sydney in early October, at the Royal Prince Alfred Hospital.

The entire system is housed in a large van, similar to a medium size bus. It weighs 8 tons fully loaded, two tons being the TV equipment. There are two colour cameras, one black and white camera, a complete control panel with colour monitors for each camera, plus a "line" monitor, full mixing facilities, provision for wipes, laps, dissolves, and similar effects, audio control facilities, and communication between producer and the "studio" staff.

The completeness of the equipment is illustrated by the fact that, at a recent demonstration for the staff of Smith

8 IMPORTANT DESIGN IMPROVEMENTS IN NEW FERROGRAPH SERIES 4



This latest development of the incomparable Ferrograph incorporates several new design improvements and will enable every Series 4 Ferrograph to be readily adapted at any future time for a variety of applications. For example, space has been provided under the Head Cover to permit Head changes and additions for monitoring, stereo playback and for lower track uses. Such heads are designed to be plugged in and are fitted with rocking facilities for azimuth correction.

Also, this new development permits any Series 4A to be instantly converted to a Series 4S merely by plugging in the additional stereo head.

Other important design improvements are:

- **The capstan motor is resiliently mounted for quiet operation.**
- **Function Switch Knob is re-fashioned for greater ease of operation.**
- **Brief Stop is now a standard fitting on all Ferrographs.**
- **The Head Cover—a one-piece moulding—is hinged for easy tape loading.**
- **The Turns Counter—now gear driven—is accurate to a turn.**
- **New standard colour scheme for all models—2-tone grey.**

SERIES 4A
With standard monaural recording/playback facilities.
Model 4 A/N ... 3¾-7½ i.p.s.
Price ... 236 gns.
Model 4 A/H ... 7½-15 i.p.s.
Price ... 252 gns.

SERIES 808
With full stereophonic recording and playback facilities.
Model 808 ... 3¾-7½ i.p.s.
Price ... 307 gns.

SERIES 4S
With optional stereo sound playback facilities in addition (when used with Stere-Ad Unit).
Model 4 S/N ... 3¾-7½ i.p.s.
Price ... 258 gns.
Model 4 S/H ... 7½-15 i.p.s.
Price ... 272 gns.
Stere-Ad Unit (when required): 88 gns.

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THE INCOMPARABLE *Ferrograph*

Demonstrations and supplies available from: **TAPE RECORDERS PTY. LTD.**
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PLEASE WRITE TO US FOR FULL DESCRIPTIVE LITERATURE AND NAME OF YOUR NEAREST DISTRIBUTOR AND SERVICE AGENT line and French Laboratories (Aust.) td., it was able to present a two hour ariety show with all the technical moothness we are accustomed to see on egular programs. This was, incidentally, e first time this equipment had been sed for such a purpose, in either Eng- and or Australia.

The colour system used is similar to e U.S. N.T.S.C. compatible colour TV ystem, but modified to the British 405 ne standard. Briefly, this provides for a igh definition monochrome picture on hich is superimposed a low definition olour pattern, it having been demon- trated that the eye cannot distinguish ne detail in colour.

COLOUR CAMERAS

The colour cameras are designed round a system of three-image orthicon ubes. From the lens light passes to a ystem of dichroic mirrors which splits he image into its red, green, and blue omponents and directs each to the ap- ropriate image orthicon. Neutral den- ity filters in the blue and red channels nable these to be matched with the reen channel and ensure that each tube s being operated on the same part of its urve.

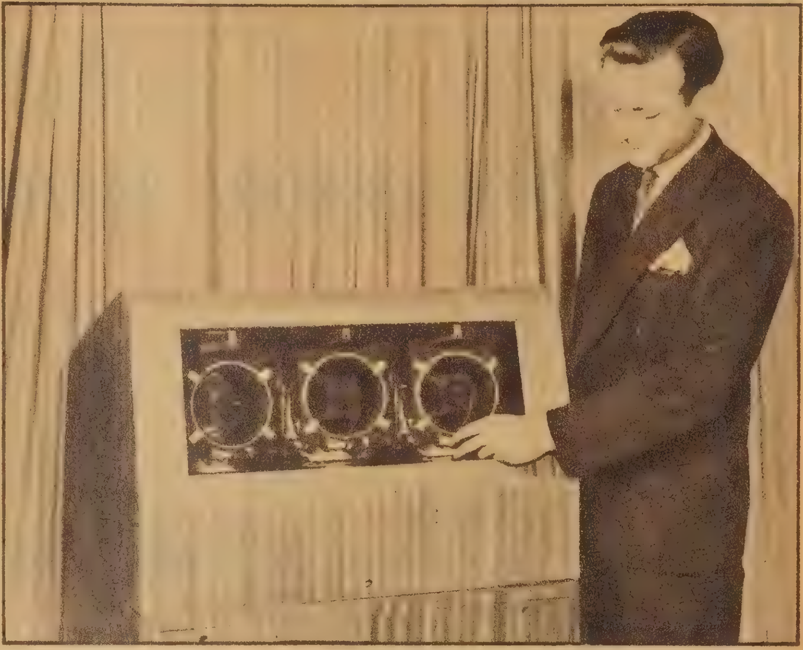
Signals from the cameras are fed to he control panel and displayed on the ppropriate camera monitors. The pro- lucer selects the most suitable picture at ny time, and this is displayed on the 'line" monitor.

The monitors are standard 21in colour V receivers, and similar sets could be sed for audience display where rela- ively few people were involved. For arge audiences, however, a projection ystem is used, capable of covering a ft by 8ft screen and coping with an udience of 300.

The projector uses three small screen, igh intensity, picture tubes, each in a onventional projection optical system. These sit side by side and the images rom all three are superimposed on the creen. One tube produces a blue image, ne a green, and one a red." The blue nd the green tubes achieve their colours lirectly from the phosphor, but the red s produced by an amber phosphor and suitable optical filter.

When used for medical demonstra- ions, it is usual to place one camera in he operating theatre, and the other in small "studio" in some other part of the building. The theatre camera is aimed at a mirror suspended at a suitable angle above the operating table, giving a "bird's eye view" of the operation.

PROJECTOR FOR LARGE SCREEN



For large audiences the picture is presented on a 6ft x 8ft screen by means of this three element projection unit. The picture can be viewed comfortably by up to 300 people.

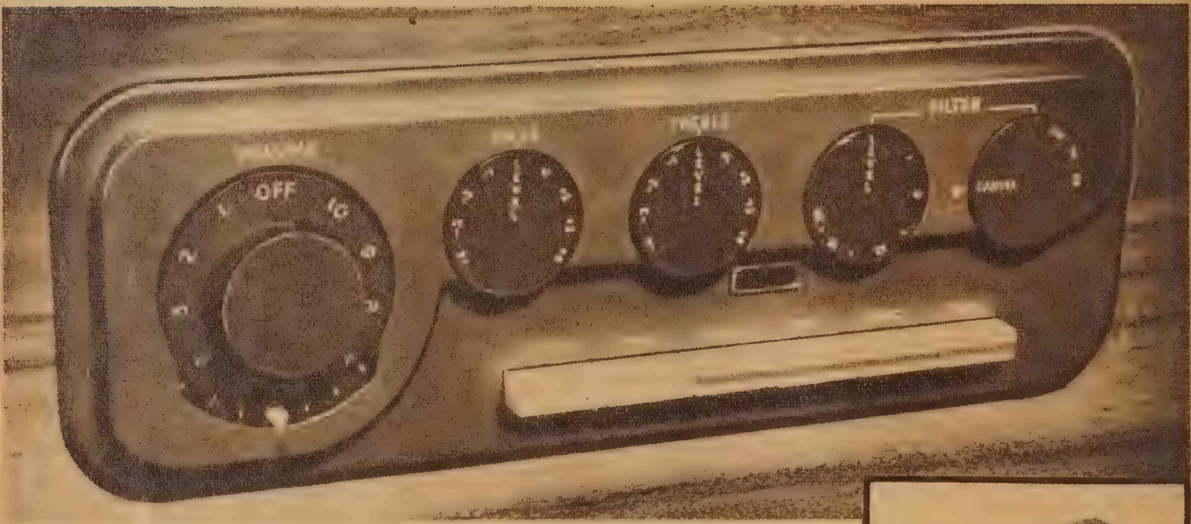
The second camera covers a panel of medical men who explain to the audience the nature of the operation, detail the case history, discuss similar cases in the past, and generally fill in the background. They may also comment during the operation and after it is concluded. The black and white camera mentioned earlier may be used during these discussions to present charts, X-rays, etc., relevant to the case.

At the staff demonstration which Radio Television and Hobbies was privileged to attend the quality of the colour was extremely good. Moreover, the quality was consistently even and there were no problems such as gross change in colour values due to lighting variations, which are often reported from overseas.

According to a spokesman for Smith Kline and French (Aust.) Ltd., the demonstrations given so far in Australia have been enthusiastically received by the medical profession and, having seen what the system will do, this is easy to believe. While it may be some time before our hospitals can afford this very valuable aid—a simpler, one camera, system is estimated to cost between £25,000 and £30,000—it would appear to be something which should be made available with the least possible delay.

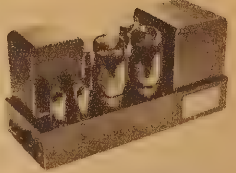
At left is shown a typical operating theatre scene. The colour camera is aimed at a mirror angled above the table and a battery of lenses enables the best possible image to be obtained. At right is the actual image in the mirror as seen by the camera. Portion of the TV camera lens can be seen in the top right hand corner of the picture.

Control Panel of *World's Finest* Stereo amplifier



QUAD 22

Incorporating the newest design refinements and greater flexibility of input, the Quad 22 is designed for monophonic and stereophonic reproduction. Quad 22, the world's finest Control Unit, has separate volume and balance (for stereo) controls, bass and treble controls, filter slope and filter switch.
Quad 22 operates from radio and microphone, disc and tape, single track and stereo. Matching is provided for any pick-up.
Select input by depressing one or a combination of the four right-hand buttons, choose any of four play-back characteristics from gramophone, then listen to "the closest approach to the original sound." And remember, this magnificent achievement is from a unit similar in size to the Quad II Control Unit.



QUAD II Amplifier

Use one Quad II amplifier with your Quad 22 Control Unit for monaural, or two for the finest stereo.
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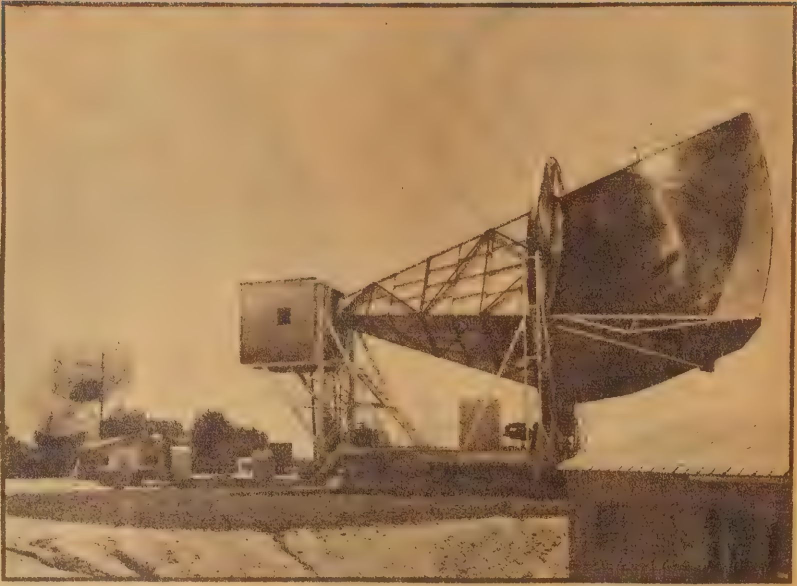
SIGNALS VIA "ECHO" SATELLITE

The recent successful launching of the U.S. satellite, "Echo," demonstrated the feasibility of using such satellites as "passive" repeaters in long distance VHF and UHF communication. Among other things, these would make possible TV relays over distances not now possible. The following report from Bell Telephone Laboratories tells how the first experimental contacts were made.



This 50ft long horn was used to receive the signals "bounced" off the Echo satellite from the west coast of the U.S. The cab at the small end of the horn houses the radio receiving circuitry. The horn is rotated by the unright wheel and also rotates about the base. The transmitting aerial, a 60ft dish, is shown at the rear.

A NEW era in communications was opened recenty as a taped message by U.S. President Eisenhower was sent across the American continent via an artificial earth satellite.

The first words—"This is President Eisenhower speaking . . . "—were received at a Bell Telephone Laboratories installation at Holmdel, N.J.

The message was transmitted from the Jet Propulsion Laboratory in Goldstone, Calif.

JOINT PROJECT

The message was part of the Project Echo experiments conducted by the National Aeronautics and Space Administration, Bell Telephone Laboratories, and the Jet Propulsion Laboratory.

The reception was of very high quality. Although the antennas lost track of the balloon for a short time, the message was successfully received several times during the 15 minutes the balloon was in line of sight of both stations.

The successful transmission of the President's message took the world one step nearer the day when transoceanic telephone calls and live television programs might be transmitted via satellites.

Early the following day came another notable success—the first two-way transmission between Bell Laboratories and Jet Propulsion Laboratory.

From Holmdel, scientists played a copy of the taped message by President Eisenhower, and from Goldstone JPL played a copy of a taped message by Senator Lyndon Johnson. The messages came in loud and clear on each end of the circuit.

PHONE CONVERSATION

The next significant break came later that same morning when Bill Jakes picked up a telephone at Holmdel and said:

"This is Bill Jakes calling Phil Tardoni at Jet Propulsion Laboratory in Goldstone. Are you reading me out there?"

"Yes, we're reading you loud and clear."

"Aha," said Jakes, "we're reading you loud and clear, too."

"Sounds pretty good," said Tardoni.

This was the first time there had been "live" conversation between the two stations, but at that point, contact was lost.

During the pass of the satellite beginning at 10.33 p.m. on the same day, the Naval Research Laboratory (NRL) at Stump Neck, Md., transmitted both tape and live voice for a 24-minute period. Reception was excellent, the best it had been up to that time.

The experiment actually began early the previous day when a sleek Delta rocket rose from the launching pad at Cape Canaveral and streaked into the morning sky.

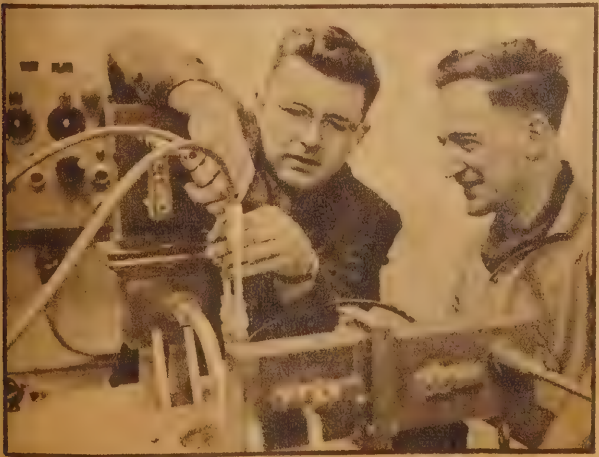
Under the direction of the Bell Laboratories Command Guidance System, the rocket reached orbital altitude and released its payload, a 26½-inch diameter magnesium container.

SPHERE INFLATED

About two minutes after the payload was put into orbit, the container was split open by an explosive charge, and the sphere inflated. Inflation was caused by the small amount of residual air left inside the balloon and by 30 pounds of sublimating powders.

The 100-foot sphere was made of a plastic film, about one-half the thickness of the cellophane on a cigarette package. Two wafer-like tracking beacons—each weighing 11 ounces—were attached to the sphere. The satellite's shell was coated with vapour-deposited aluminium to provide high reflectivity.

To transmit messages, Jet Propulsion



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Two Bell workers make final adjustments on the Maser Amplifier. Using a ruby as its central element, the Maser is refrigerated by liquid helium to -460 degrees F.

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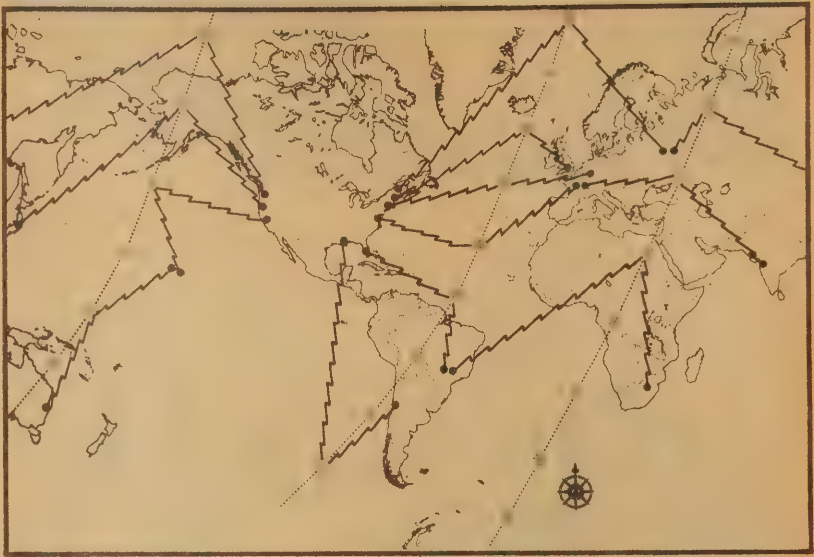
PLAN FOR WORLD-WIDE UHF LINK



The Bell Telephone Laboratories plan to provide world-wide UHF communication by means of a large number of satellites in several orbits. With sufficient satellites in orbit, there would always be at least one within line of site of the planned terminals.

aboratory scientists beamed microvave signals at the 100-foot diameter phere. The sphere, 1,000 miles above he earth, reflected the signals and they vere received at Bell Laboratories by a horn-reflector" antenna system designed specially for the space communication xperiments. They aimed the horn reector antenna directly at the orbiting phere and received the JPL signal. JPL ransmitted on a frequency of 2390 Mc.

To make practical use of the minute mount of UHF energy reflected from he 100ft diameter sphere, 1,000 miles bove the earth, very special receiving ear was required. Bell scientists claim hat the system used in the most sensiive voice channel radio receiver yet uilt. To produce it they made use of hree unusual pieces of equipment.

SPECIAL EQUIPMENT

One is the "horn antenna" already nentioned, and shown in the accompanying photograph, another a specially leveloped Maser amplifier using a ruby s its central element, and refrigerated o near absolute zero with liquid helium, nd the third a negative feedback demodulation system in the associated FM eceiver.

The latter is the invention of Bell ngineer, Joseph G. Chaffee, who first onceived the idea over 27 years ago.

"It never entered my mind in those lays," Mr Chaffee said recently, "that he receiver circuit might ever be used or outer-space communications."

Yet today his invention, although ittle used during the intervening years, as become an important part of a Bell ystem installation at Holmdel, N.J.

THE PROBLEM

With the advent of the space age, Bell Laboratories scientists working toward satellite communications were faced with a problem. Radio signals bounced from satellites across the vastness of space would be very weak, and the radio noise from stars and the atmosphere would be a significant factor.

William M. Goodall recalled the Chaffee system. Using this principle along with the other receiver improvements, available transmitter power would be sufficient for bouncing a high-quality signal off a satellite.

Another radio research man, Clyde L. Ruthroff, went to work developing the receiver for the Holmdel installation. Early this year Mr Ruthroff reported:

"It works just as Chaffee said it would."

It reduced the noise output, as compared with signal output, one hundred times.

All the experiments were aimed at determining the technical feasibility of commercial overseas communications by way of reflecting, or passive satellites.

"ACTIVE" SATELLITES

Bell scientists have also been investigating another possibility — "active" satellites, which would carry electronic equipment to receive radio signals and send them back to earth. Engineers are developing the rugged, long-life electronic devices and power supplies that would be necessary for a commercially feasible "active" satellite.

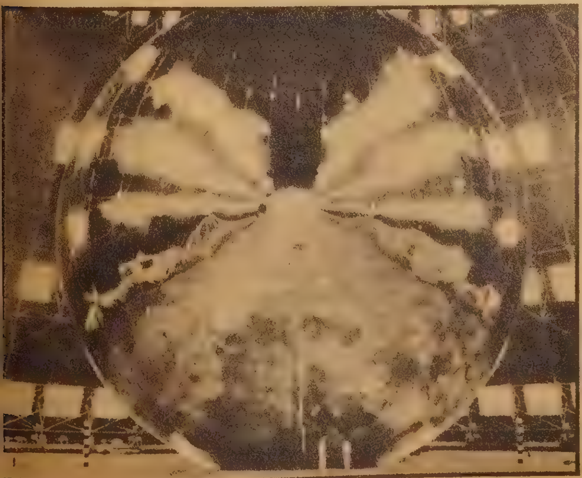
In recent testimony before the Federal Communications Commission, the Bell Telephone System outlined a preliminary plan for a world-wide communication network utilising active satellites. About 50 active satellites in random polar orbits at an altitude of 3,000 miles could provide communications facilities between the United States and all areas of the world, Bell officials said.

All proposals for communications satellites are based on the principle that they would enable long-distance transmission of high-frequency radio signals, which travel in straight lines and are therefore normally blocked by the earth's curvature. These signals could travel in straight lines up to a satellite and then be reflected or retransmitted back down again.

CABLE LIMITATIONS

Telephone calls are already transmitted across oceans by low-frequency radio and by deep-sea cables. But the number of radio channels is limited, and low-frequency radio transmission is subject to natural interference. Cables also are limited in the number of channels by technical considerations, chiefly the necessity of building cables with extreme long-life capability.

Cables are being improved and almost certainly will continue to be used and expanded indefinitely for overseas communications, whatever the success of communications satellites. Communication by satellite, however, offers a complementary means of communication having greater potential capacity. Television signals today occupy the equivalent of 500 to 900 voice channels. Communications satellites of this or greater capacity now appear feasible, but are still in the future.



☆

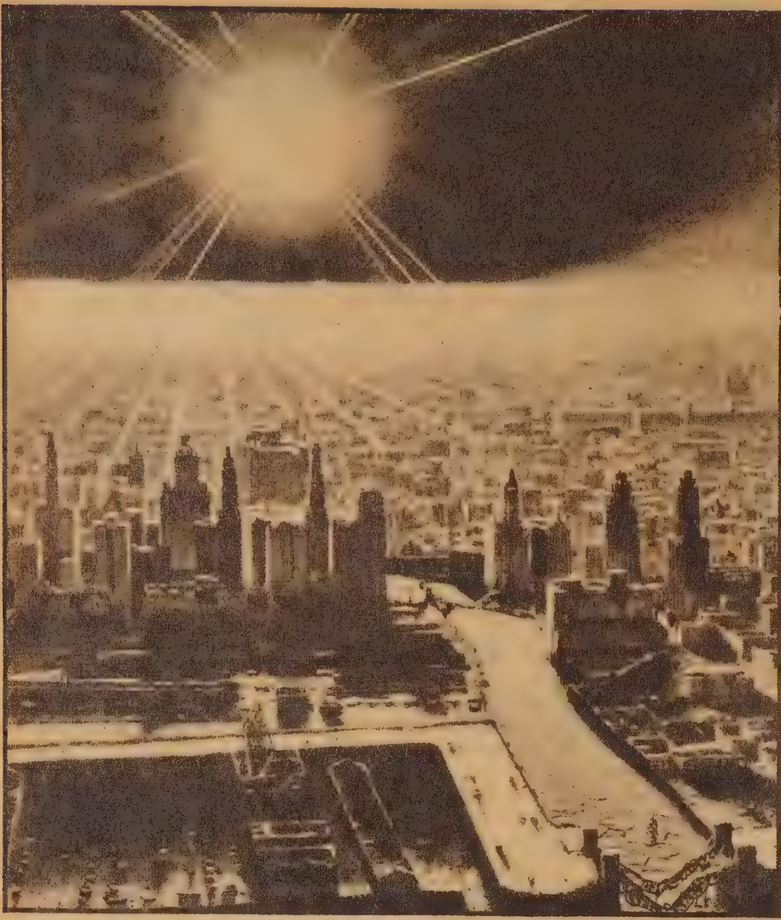
The plastic balloon which made it all possible. Shown here during inflation tests, it is 100ft in diameter and coated with a deposit of aluminium. Note the two tiny figures in the foreground.

☆

"The End of the World" - Soon?

The eventual destruction of the earth is something which seems to have beset the minds of people of all races. Scientists have suggested many ways by which it could come about but none of them look like being the cause for any immediate worry.

by Calvin Walters



The day the sun explodes! American artist Chesley Bonetell's impression of the city of Chicago a few moments after such a catastrophe. Lake Michigan and the Chicago River have already boiled away and all life has perished.

MANY beliefs have been held about "the end of the world" and many theories have been worked out over the centuries.

There always appears to be someone who manages to get quite a following when he predicts that the world will come to an end at some specified date and time. This happened again quite recently and has been happening for many centuries.

None of these forecasts has been accurate. How the "prophet" manages to talk himself out of the dilemma is rarely told but he must be a pretty good talker, to say the least.

There are a lot of people, of course, who think that this world of ours is not much of a place to live in. No doubt, many have a fairly good case. The distribution of happiness and contentment throughout the world is rather haphazard.

Even to those who have plenty of what it takes, things seem a bit grim sometimes, what with tax collections, doctors, car repairs, gardens to dig, poker machines, mother-in-laws, municipal rates, work and so on.

In fact, if you work it out, the cove who hasn't much of what it takes may be a lot better off than the other cov He isn't worried with tax fellows; he ca get a doctor for nothing in a public hospital; he has no car to go bung; he can afford to play poker machines; he rent a house and pays no rates; he can't b bothered with a garden!

That leaves him with work and mother-in-law. Perhaps he doesn't work so that may still leave him with mother-in-law. What life is like unde such conditions depends on mother-in-law but, at least, he has only one thin to worry about.

The trouble with most of us is tha we haven't had much of a chance t settle down on this old earth of ours We are too ready to condemn one another when, in fact, we are no mor than tiny children by comparison witl our past and possible future.

Let us look at things in the way it ha been explained by Kenneth Heuer, Fellow of the Royal Astronomical Society of London:—

It was about one million years ago that man first appeared on the earth There could be some argument abou this but it does not matter a great deal

MERE INFANT

It has been estimated that the eartl has a useful life of at least another 2,00 million years.

If the life span of a man is taken a 100 years, then Heuer somehow calculates that man at present is equivalen to being only 18 days old.

Now, says Heuer, an 18-day-old infan can't even sit up. He cannot reason anc is selfish. So mankind is selfish and cannot reason properly. Fifty years of ou race is a little over a minute of its life

So give us a chance will ya, huh! We are only kids.

But these kids have done a pretty smart job over the minutes of their life.

Think of the wonderful things we have accomplished even over the last 50 years, the minute of our lifetime just passed. Radio, television, plastics, jet planes, atomic energy, new metals, new fuels, new all-sorts of things! We are still young, we have to grow up. Then see what we can do. We have nearly 2,000 million years to go yet.

In any case there may be a better way of getting away from the earth than being destroyed. We will be able to take a space ship.

It is certain that space travel will become a reality and some of us may be looking forward to a trip among the stars, even if it is only to have a look at our horoscopes, those shining constellations with which astrologists sometimes horrify us in the daily papers and magazines.

Some time ago I wrote an article exlaining some of the hazards with which space ship would have to contend on journey through space. Among these azards were such things as comets, neteorites, asteroids, great hunks of ocks floating about, clouds of dust, osmic rays, exploding stars and so on.

These are some of the things which essimists use to destroy the earth in heir far-flung imaginations.

Some say that we will be collected by comet. Others say an asteroid will get ff course and collide with the earth. ome say the sun will explode and burn s to a frazzle. Others say the sun will ie out and we will all freeze. Some ay we will pass through a comet's tail nd we will all be asphyxiated with a oison gas. Others say the earth will low up.

They cannot all be right. Maybe none f them will be right. Let us look at he matter from a purely scientific point f view, leaving out all the hokus and ee what possibilities there are in the arious theories.

SUN WILL EXPLODE

Perhaps the most popular idea is that he sun will explode and fry us to a urn. We will start with that one.

Do suns explode? Definitely yes. Suns are exploding all the time all hrough the universe.

It must be remembered that our sun s not the only one in the universe. Most of the stars seen in the sky are uns of some sort. They shine by their wn light, as distinct from the planets which shine by the reflected light of a un.

The studies of many years have shown hat most of the hundreds of thousands f stars in the universe are very stable in heir behaviour but, every now and gain, a star will appear to flare up with remendous brilliance finally to die away never to be seen again. It apparently xplodes and shatters itself.

These outbursts are called novae or ew stars. One of the most spectacular f these was seen in June, 1937, in the Constellation, the Lizard.

At the time of these tremendous explosions the star increases in brightness to a very great magnitude. Expanding shells of matter are ejected from the star. These travel at speeds estimated to be some 2,000 miles a second.

Within our own galaxy, the Milky Way, about 20 stars explode every year. Some of these have increased in brightness to about one hundred thousand times the luminosity of our own sun. These are the "weaker" explosions called novae.

There are other much more powerful explosions called supernovae. These are more rare and do not occur in our own galaxy more than once every two or three hundred years.

DESTRUCTION

During these explosions the star may increase in brightness to a 1,000 million times the brightness of our sun so that tremendous destruction must take place for millions of miles in surrounding space.

After the explosion the star gradually diminishes in brightness and may disappear altogether after some years.

A supernovae occurred in our own galaxy in the year AD 1054. This was recorded by the Chinese astronomers of the time.

After a period of 900 years the gaseous matter from this explosion has spread into a great nebula 30 million miles across, known as the Crab Nebula.

Nobody seems to have much of an idea of what causes such explosions. Many theories have been presented from time to time but no satisfactory answer has been found.

One great astronomer, Gustav Stromberg, of Mount Wilson Observatory, has suggested that planets may be the condensed fragments of a supernovae explosion. If this is so then our own planetary system may have been the result of such an explosion of our own sun.

What are the chances of our sun exploding into a novae or supernovae and what would be the consequences?

Perhaps the answer has been given by George Gamow, of George Washington University. He estimates the age of our own particular universe at 2 billion years and, as about 20 stars explode each year in the Milky Way, some 40 billion stars must have exploded during that period.

This means that as the Milky Way contains about 40 billion stars, each star must explode about once during its history.

REMOTE CHANCE

According to Gamow the chances of our sun exploding in the near future is about one in thousands of millions.

As each star explodes once in a lifetime it may be that our sun had its nova explosion in the remote past and perhaps this great catastrophe gave birth to our planets.

Whilst such a thought may ease our minds to some extent, the knowledge of what would happen if an outburst did occur paints rather a grim picture.

About seven minutes after the explosion a searing heat would fall on the side of the earth turned to the sun. The heat would be such that the seas would boil, giving off vast clouds of steam. This would give rise to vast upward cur-

MATURITY IS A LONG WAY OFF

In the life of the earth, mankind is but a tiny infant. According to some authorities, no more mature than an 18-day-old child. Small wonder that he has a lot to learn about this earth and how to live on it.

"There are a lot of people who think this world is not much of a place to live in." Typical, we imagine, would be this starving Indian family, victims of one of India's tragic famines. Man is learning to avoid such tragedies, but has still a long way to go.

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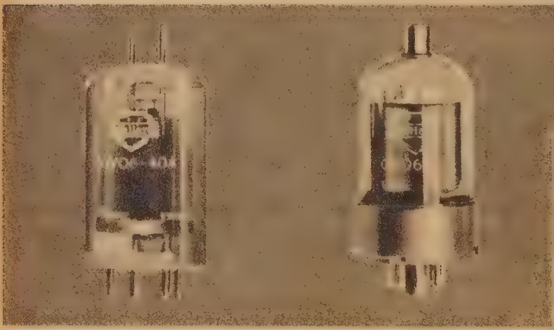
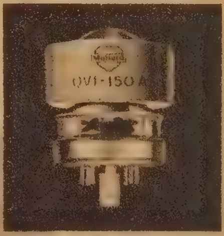
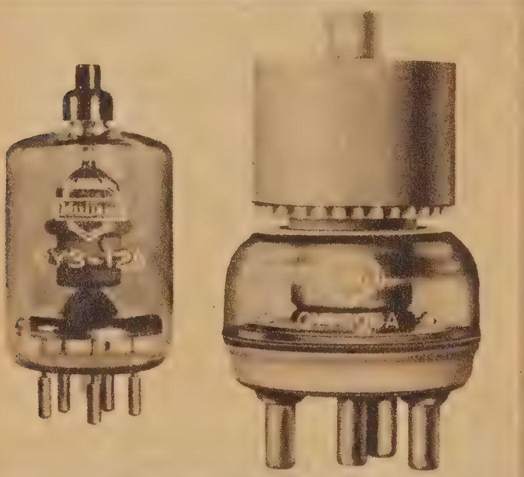
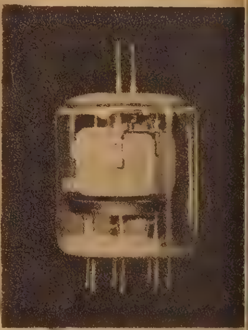
Transmitter designers are now offered a complete range of V.H.F. tetrodes by Mullard.

These high efficiency, high gain tetrodes make possible the design of transmitters with fewer valves and, consequently, reduced initial cost.

The higher overall efficiency of equipment fitted with Mullard tetrodes results in lower running expenses — a factor in the growing popularity of these valves in the world market. Further details of these tetrodes and other Mullard valves and tubes may be readily obtained from the address below.

Mullard
QY5-3000A


PRINCIPAL CHARACTERISTICS

MULLARD TYPE No.	AMERICAN TYPE No.	CV TYPE No.	DESCRIPTION	BASE	HEATER (V)	HEATER (A)	Va max. (V)	pa max. (W)	TYPICAL LOAD POWERS AND FREQUENCIES (W)	TYPICAL LOAD POWERS AND FREQUENCIES (Mc/s)
QV06-20	6146	CV3523	V.H.F. Power Tetrode	Octal	6·3	1·25	600	20	52 25	60 175
QV1-150A	4X-150A	CV2519	V.H.F. Power Tetrode	B8F	6·0	2·6	1250	150	195 140	165 500
QQV03-20A	6252	CV2799	V.H.F. Power Double Tetrode	B7A	6·3 12·6	1·3 0·65	600	2 x 10	48 20	200 600
QQV06-40A	5894A	CV2797	V.H.F. Power Double Tetrode	B7A	6·3 12·6	1·8 0·9	600	2 x 20	90 60	200 475
QY3-125	4-125A	CV2130	V.H.F. Power Tetrode	B5F	5·0	6·5	3000	125	375	120
QY4-250	4-250A	CV2131	V.H.F. Power Tetrode	B5F	5·0	14·0	4000	250	1000	75
QY4-500A	4X-500A	—	V.H.F. Power Tetrode	—	5·0	13·5	4000	500	900	110
QY5-3000A	6076	—	V.H.F. Power Tetrode	Special 4-pin	6·3	32·5	5000	3000	4100 2600	75 220

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MT96

rents of hot air, with cold air from the poles violently rushing down to replace it.

This would result in hot rain pouring down on the earth. The continents would become red hot. Every living thing would be destroyed.

The whole earth would later become enshrouded by vast shells of hot gas from the sun. The moon would explode because of the expansion brought about by the awful heat. People on the night side of the earth would be destroyed by the hot convection currents rushing round from the other side.

This is a pretty crook picture of the whole affair and one can only hope that it will never happen. Astronomers think the chances are slight indeed. Let's hope so.

Now what about the other idea that the sun will die out and that we are destined to freeze in a sunless world?

I like this idea a little better because we could have some warning of the event which would give us a chance to make ready for it.

HOTTER, THEN COLDER

However, if the theory of George Gamow is correct, things won't work out that way at all because, as the sun dies out, things will get hotter and hotter. We will all be burnt to a frazzle before ice covers the planet. It works something like the following.

The energy of the sun is derived from the conversion of hydrogen into helium. Helium presents a greater barrier to the transmission of energy from the centre of the sun to the surface.

The more helium produced therefore, the greater is the amount of energy concentrated in the centre.

This accumulation of energy increases the rate of heat production. Thus the temperature will rise which will, in turn, increase the rate of production of energy. This goes on and on. The more energy the more heat. The more heat the more energy.

Now this increase of temperature also burns up more hydrogen and as this is the main fuel of the sun the more it burns up the less it has.

Whilst this process is taking place the sun is growing larger and hotter until, at last, with the burning up of the last vestige of hydrogen, the sun is 100 times hotter than before.

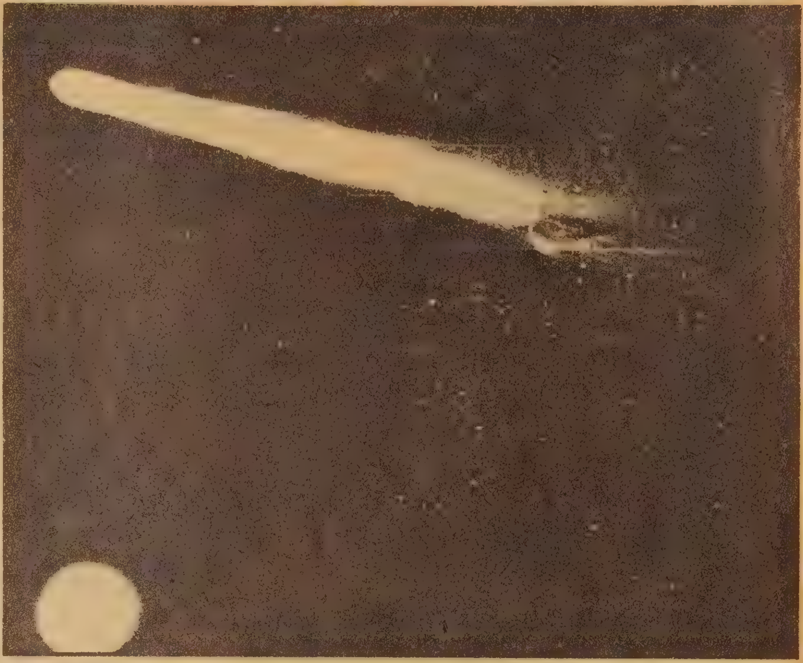
After this it will begin to get smaller and cooler but by that time everything on earth will have burnt to a cinder.

LONG WAY OFF

It has been estimated that it will take about 10,000 million years for the sun to reach its highest temperature before it begins to die out. It will require another 5 million years to shrink back to its present size and energy output. After that, it will cool off rapidly, to be finally covered in ice, accompanied by its frozen planets.

During all these years man no doubt could adapt himself by some evolutionary process to withstand the changing conditions, just as he has in the past millions of years. When the sun begins to cool off he will have to change again to withstand the gradual cold so that, if Gamow's theory is correct, we have a busy time ahead of us for the next 15 million years.

WILL EARTH & COMET COLLIDE?



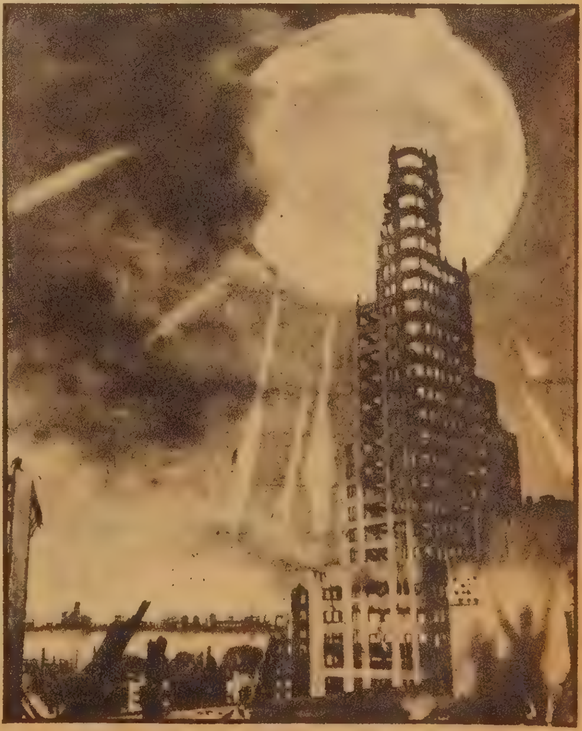
Collision with a comet is one of the favourite fates predicted by those who feel the world is destined for a violent end. The most famous of all is Halley's Comet, shown here with the planet Venus (bottom left). In fact, most fears concerning comets are groundless.

Evidence of such events as outlined above can be found in the stars in outer space. There are many stars which have exhausted their fuel and are gradually cooling off. As Heuer puts it, "wound up watches and wound up suns must run down some time." It is considered that the death of the sun and stars is inevitable but when, no one can know.

Now what about the idea that we will be collected by a comet. This seems to have been a favourite phobia of the human race for many centuries. Every time a large comet appears millions of people all over the world quake with fear. Let's have a look at that one.

What is a comet. A comet is the garbage can of the heavens.

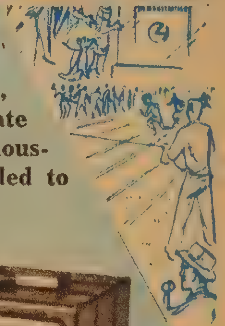
(Continued on Page 123)



The approach of the moon to within a few thousand miles of the earth is another prediction. The moon would break up and shower the earth with huge meteors. This picture is another Chesley Bonestell impression.

PUBLIC ADDRESS AMPLIFIERS

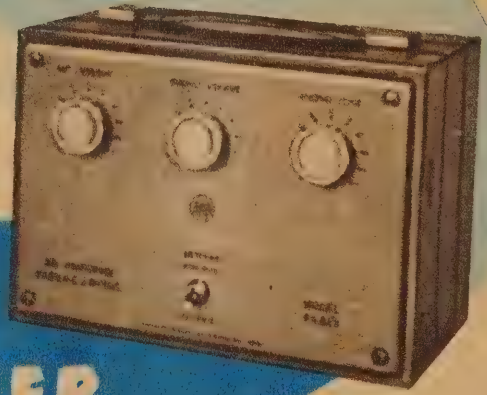
DUAL OPERATION MAINS OR BATTERY



Type PA828 amplifiers may be operated from 240 volt or 6 volt battery supply, changeover being effected by alternate cables which are stowed in rear of housing. A standby switch is provided to conserve battery life.

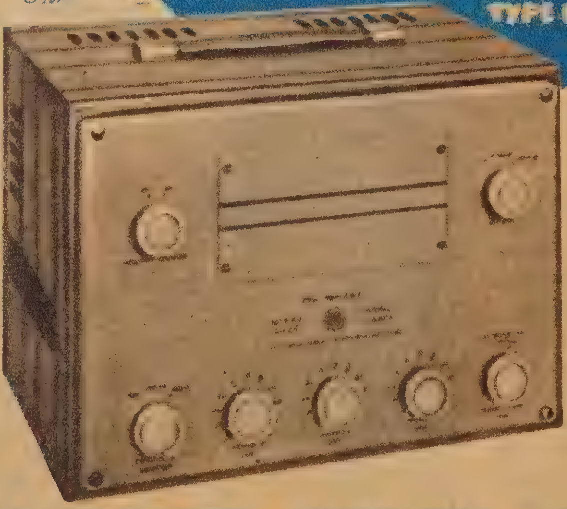
5 WATT AMPLIFIER

TYPE PA 828



20 WATT AMPLIFIER

TYPE PA 829



Type PA829 20 watt mains or 12 volt battery amplifier provides all facilities necessary for P.A. Hiring.

These include two microphone channels with third optional channel for microphone or pickup. Either high or low output pickups can be used. Features include a battery saving switch and a bass cut switch to control L.F. response when using horn speakers. A plug-in V.U. meter and monitor speaker with their associated switches are ancillary units.

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Technical Review

PLANTS MAY SOLVE OXYGEN-IN-SPACE PROBLEM

Oxygen for the space traveller is one of the major problems connected with space exploration. Many suggestions—including hibernation — have been made, but a completely self-contained system based on normal animal-plant life relationship appears to be the most logical.

☆

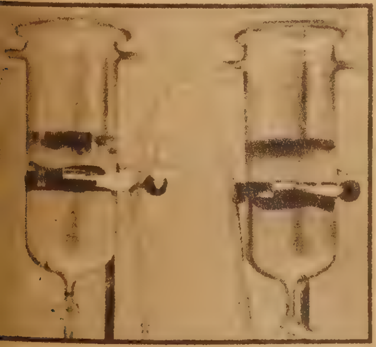
A major advantage of the Duckweed form of plant is that it may be grown on sheets of absorbent paper, supported on simple frames, and requiring a minimum of space.

☆

F a future astronaut should remark that "it's a small world," he would e stating a fact, not a bromide. Beause a spaceship in a sense must be a niniature earth, and earth itself is a rge spaceship orbiting the sun.

Both earth and the spacecraft of the ature represent a "closed ecology"—at is, all elements of the system must e regenerated in a cyclic fashion. An exellent example is the atmosphere. In e earth's ecology, the air is constantly eing resupplied with oxygen by plants s a by-product of photosynthesis. Man d other animals breathe in necessary xygen and expel carbon dioxide which, turn, becomes a raw material for hotosynthesis in the plant.

A spaceship can take a fairly large pply of oxygen on a short voyage. owever, a point is reached on an exnded trip where it is inconvenient, if ot impossible, to sustain life on an air pply brought from earth. The same is true of nuclear submarines that remain submerged for long periods. A regenerative system becomes necessary to provide continuous production of oxygen and removal of carbon dioxide for indefinite periods.



A variety of Duckweed plants were tested under carefully controlled conditions to determine their gas exchange rates.

One way might be to follow the example of the earth and fill the craft with plants. However, the higher plants have relatively low proportions of photosynthetic apparatus (leaves) compared with other structures (roots, stems, etc.). They are, therefore, inefficient in relation to the large amount of room they would take.

UNDERWATER PLANTS

Underwater plants such as algae are almost entirely made up of photosynthetic structures, and are much more efficient for their volume. But here the gas exchange takes place in a liquid, necessitating bubbling gases through water—no mean trick at zero gravity conditions.

Plants that grow on the water surface might offer a better solution. With this in mind, Luman Ney and Josephine Huang investigated the duckweed family in a study for the Office of Naval Research.

Duckweed is a green, surface-growing plant. Growth rates and characteristics of five species were studied under different conditions of light, temperature, nutrients, and carbon dioxide concentration. From those, Lemna minor was selected for further study of gas exchange rates.

The researchers calculated that 25 square feet of growing Lemna minor would supply enough oxygen to support one man, meanwhile maintaining the carbon dioxide at a reasonable level.

Moreover, this species can be grown on supporting matrices, such as absorbent paper, as well as on water. One end of the matrix is simply dipped into a reservoir of nutrient solution. Such an arrangement can be either horizontal or vertical. Thus, one could set up a system of small, vertical, reinforced paper panels with Lemna growing on both sides of each panel. This plus light sources and supporting pumping systems would occupy 75 to 100 cubic feet for each man in the spacecraft. Bottled oxygen occupying similar space would not supply a man indefinitely, and the problem of carbon dioxide removal would still be present.

Further studies of duckweed are planned, including a search to find or breed an even more useful strain. It, or something similar, may be a useful and necessary inhabitant of the "small worlds" we will send out to the distant large worlds in space.

[From "Research for Industry," U.S.A.]

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REVIEW—CERAMICS WORK AT 4,000 DEGREES F.

An entirely distinct category of high-temperature ceramic materials, born in the white heat of advancing propulsion concepts, is being developed by materials-research engineers of the Boeing Aero-Space Division in Seattle. The ceramics are resistant to the intense oxidation and gas-flow erosion encountered in environments simulating combustion chamber conditions at material temperatures above 4,000 degrees F.

☆

Clad in protective clothing, a laboratory worker tends one of the furnaces in which the new ceramics are being developed. It is hoped they will benefit aircraft and space research.

☆

AMONG other qualities, the new ceramics will withstand combustion extremes of high-performance aircraft engines burning special fuels. These materials are being developed for the Air Force Materials Laboratory, Wright Air Development Division, under the direction of Lt. L. N. Hjelm.

The new ceramics are valuable in a variety of ways. Ramjet engine components such as liners, flame holders and nozzles may be made either of refractory metal and coated with these materials by flame spraying, plasma spraying or trowelling, or may be fabricated as solid-body ceramics, reinforced or unreinforced. The ceramics may be reinforced with metal wire when desirable, just as concrete is reinforced with metal rods.

POSSIBLE USES

One way the new ceramics might be used would be as combustion-chamber walls having such resistance to high temperature that no cooling jacket would be required. Engines with combustion chambers of this kind would have a number of advantages over the cooled type.

The use of special fuels to obtain more power from high-performance rocket and ramjet engines creates higher temperatures than in previous engines. Consequently, new heat-resistant materials are needed.

A case in point has been the search for suitable structural materials for hot-zone areas of powerplants using the special fuels. Known materials have not been able to withstand the destructive effects of special-fuel super-hot gas flows through combustion chambers. Even the hardest, toughest metals, under these conditions have critical temperature limits far below the 4,000 degrees F. estimated as maximum engine-wall temperature.

Boeing engineers have found new heat-resistant ceramics through a step-by-step approach. Like recipes for hash, the number of possible ceramic compounds is infinite. Reinforced ceramics, considered to offer the best promise, present some thermal expansion problems when used with metals.

A comprehensive state-of-the-art survey made at the beginning of the program yielded little or no information on stable materials above 4,000 degrees F. Test equipment was prepared to simulate conditions of use in ramjet engines. Mechanical and physical properties of ceramic materials are being matched with those of prospective metal reinforcements or sub-structures to get the best metal-ceramic relationships.

Based on initial considerations of stabilisation in a preferred crystal structure and desirable physical properties, 76 compounds were prepared. These were tested for erosion and oxidation in an oxy-acetylene flame at material temperatures in excess of 4,000 degrees F.—close to half the surface temperature of the sun. The test method involved a 10-minute pre-heat period, a 15-minute period in excess of 4,000 degrees F., then gradual cooling for 10 minutes.

Several pure ceramics and compounds, with heat resistance and other properties which allow their use with refractory metals, have been selected thus far. They are hafnia, zirconia, thoria and compounds of hafnia-thoria, hafnia-lanthana and hafnia-neodymia.

FUTURE PLANS

Much remains to be done. Work is presently under way to determine coefficients of thermal expansion and thermal conductivity, density, and tensile and flexural strength. Also in progress is a study to determine the chemical interactions with metal reinforcements such as hafnium, platinum, tungsten, molybdenum, tantalum and zirconium at 4,000 degrees F.

Binders to achieve cohesion in the construction of large components and of trowelled, low-temperature-cured coatings have been developed, evaluated and are being refined. A zirconia binder has been developed which can be moulded at room temperature, cured at 800 degrees F. and is dimensionally stable to above 4,000 degrees F.

Tests of small-scale components will be made to evaluate fabrication techniques and to determine the thermal capabilities of various shapes.

Another worker tests one of the ceramic samples with a 4,000 degree (F) oxy-acetylene flame. Prior to the present research program, very little was known about the behaviour of ceramics at such high temperatures.

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NEWS FROM National

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REVIEW—TV TRACKER RECORDS EYE MOVEMENTS

Light reflection from the eye indicates direction of view. One TV camera monitors the scene, a second camera picks up eye light reflection. Camera outputs are mixed, and the eye focus point is displayed as a bright spot superimposed on a televised picture of the scene. Photocells on a monitor screen convert bright spot position data to digital form.

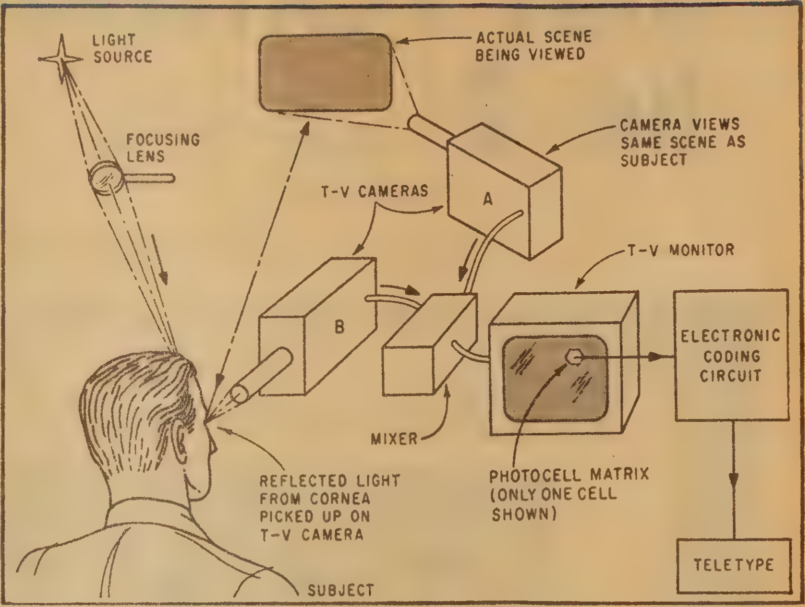
LIGHT SOURCE
ACTUAL SCENE BEING VIEWED
CAMERA VIEWS SAME SCENE AS SUBJECT
FOCUSING LENS
T-V CAMERAS
A
T-V MONITOR
B
ELECTRONIC CODING CIRCUIT
MIXER
REFLECTED LIGHT FROM CORNEA PICKED UP ON T-V CAMERA
PHOTOCELL MATRIX (ONLY ONE CELL SHOWN)
TELETYPE
SUBJECT

Fig. 1. Subject and camera A view the same scene; camera B picks up light reflected from the subject's eye. The camera outputs are then mixed and presented on a monitor screen. Results may be filmed or recorded in code on punched tape.

OW a man moves his eyes, and where he actually looks while he is dying a fixed or moving scene are estions arising in many areas of plied science.

Such questions are of increasing imrtance to engineers, because the equipent they are designing is, despite wider e of automatic control systems, making eater demands upon the human operor.

IRCRAFT PROBLEM

For example, although the pilot of a aircraft may be relieved of much utine flying by automatic equipment, must nevertheless be ready to act th speed and decision during take-off d landing. As the speed of the aircraft creases, this demand upon the man comes greater.

Advancing technology, while releasing an from many routine operations, is at e same time making more exacting mands upon him during those periods en his judgment is indispensable.

The same holds true for many other an-machine situations in which inforation is conveyed to the brain chiefly the eyes.

One way of reducing the time delay this human portion of the servo loop to present the information to the man a way that helps him to understand as quickly as possible.

For example, the layout of instruents in an aircraft cockpit has often en governed mainly by engineering pediency, little or no consideration ing given to the capabilities or limitans of the pilot.

OCKPIT DESIGN

As soon as we try to redesign such ings as cockpit layout, to present inrmation in the best possible way, we e faced with the problem of finding out w people actually do look at the disys before them.

There are various ways in which ovements of the human eye can be amined. One method is to use the rection of light from the front surface the eye. This is called the corneal lection, and can be seen as a bright ot if an eye is viewed when a light ls on it. The spot moves as the eyell moves.

Within about 15 degrees on either side the central axis, the movements of s corneal reflection, and the direction of gaze, have a direct correlation. The corneal reflection was originally used in 1907 by Dodge to study eye movements.

In the device to be described, Fig. 1, this corneal reflection is viewed by a television camera.

A second television camera is used to survey the scene that the subject is studying, and the two camera outputs are mixed electronically. The result is a composite television picture which shows the scene with a bright spot of light superimposed upon it.

POSITION OF GAZE

This spot of light indicates the subject's position of gaze from instant to instant.

The camera viewing the corneal reflection is mounted with its lens close to the eye, and the subject's head is kept still by a bite bar and neck support.

The television camera is at 45 degrees to the right of the line of regard, with the lens at eye level and approximately two inches away from the eye. The light source is 45 degrees to the left, and is focused to cast an image at the surface of the cornea.

The beam is very narrow and although it falls directly on the eye it is surprising how little it interferes with vision; presumably because only a small part of the light enters the eye, the rest being reflected by its surface.

Magnifications of the order of 100 are required since the corneal reflection moves only about 2mm for a horizontal movement of the eye through 20 degrees of arc.

The second television camera provides the visual scene, and the outputs of the two cameras are mixed in an electronic mixing unit so that the images from each of the two cameras are fed to the same recording screen.

This combined eye-scene picture can then be viewed directly by the investigator and recorded by a motion picture camera.

The eye spot and the visual scene are calibrated by asking the subject to look at known points within the scene.

Successive eye fixations are shown as bright spots of light on a screen, but to extract the maximum information it is necessary to analyse the sequence in which they occur.

This can be done by examining the film frame-by-frame and noting the successive positions of fixation, but it is more convenient to record the position-data in coded form on punched paper tape.

PHOTOCELL MONITOR

Since the eye spot appears as a bright spot of light it can be used to activate photocells mounted on the monitor screen surface. Each cell will be energised only when the eye spot is focused on it, permitting a coded output as the spot moves about the screen.

Outputs from the photocells are used to drive a coding circuit. This coding circuit gives an output consisting of direct current signals in the teletype code.

Teletype signals are then used to operate a teletype printer perforator whose output is a paper-tape with both typed characters and punched holes. (From "Electronics.")

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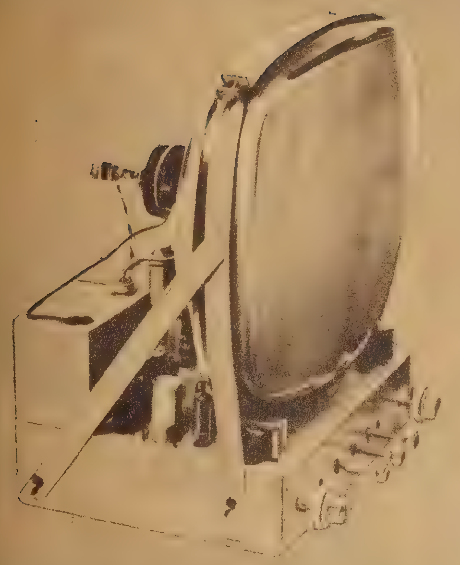

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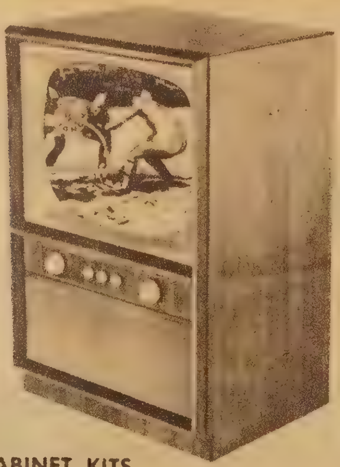

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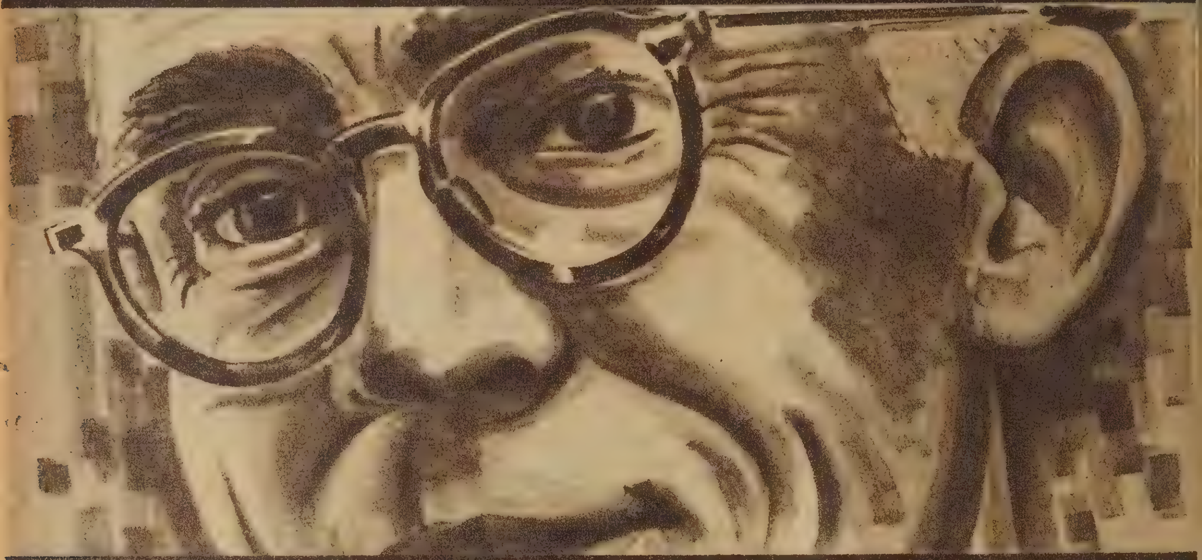

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SCIENTIFIC & INDUSTRIAL NEWS

CHLOROPHYLL MADE SYNTHETICALLY

ERMAN and American scientists have succeeded after more than 20 ears in synthetically producing chloro-hyll, the substance which makes plants reen and enables them to use the energy f sunlight for chemical processes.

The achievement was reported by the nformation bulletin of the Association f the German Chemical Industry, which ailed it as a major feat.

The scientists concerned were Prof. Iartin Strell and his assistant, Dr Anton alojanoss, of the Institute for Organic hemistry at Munich Academy, and Mr . B. Woodward, of Cambridge, Mass.

The bulletin pointed out the possible ong-term significance of the scientists' ork. It may eventually make possible ne synthetic production of carbo-ydrates, fats and vitamins for food.

NOVEL LEATHER

NEW process has been developed for converting the major part of the rotein solids of the hide into a solution, hich can then in its turn be converted nto an extruded continuous sheet of re-onstituted leather.

The operation of the process depends n the liquefaction of the collagen, hich forms 85 per cent of the protein olids of the hide.

The finished production has a mechani-al, chemical and physical behaviour qual to that of a high proportion of the eather now made. The fact that it can e extruded in any thickness or shape neans that there is less wastage through in irregularities and blemishes during rocessing.

[Armour Leather Company, 420 West andolph Street, Chicago, Illinois, .S.A.]

LONGER LIFE FOR CAR SILENCERS

MERICAN motor car makers are trying two lines of attack on the oblem of corrosion in exhaust silencers - the component with the shortest life the whole car.

American Motors, which pioneered the nall American car, will fit a ceramic-ated exhaust system to its 1961 models. rd is trying stainless steel.

Exhaust pipes and silencers take as ich or more punishment than any her car part. They handle hot gases ile the car is running; sulphur in the trol mixes with water condensed from exhaust and forms corrosive acid; d there is almost always condensed ter to accelerate normal rusting when car is idle.

For this reason, cars used continuous-such as taxi cabs, generally show a ger silencer life. Those in private s frequently last only eight to 15 nths, and there is a flourishing busi-s in replacements for them. American tors aims to make this unnecessary h an exhaust system which will last life of the car.

In the ceramic process, the silencer assembly and tail pipe will be dipped in a thick mixture of water, borosilicates, borax, titanium oxide and other refractory materials. The whole thing is fired at 1,500 degrees Fahrenheit to produce an enamel coating three-thousandths of an inch thick. The additional cost is estimated at about 3.50 dollars per car.

BRITISH INSTALL NEW AIRCRAFT LANDING SYSTEM

A NEW instrument landing system has come into operation at London Airport.

Installed by Standard Telephones and Cables Ltd., it is claimed to be more accurate and more reliable than previous methods.

The equipment has been ordered for installation at many major airports, including Gatwick, Prestwick, Ringway, Renfrew, Zurich and Brussels. The Canadian Department of Transport has also ordered 35 installations based on the Standard Telephones and Cables design.

The system is claimed to be so accurate — its margin of error is said to be only 5ft on a 12,000-foot run-in — that it might be applicable for automatic landing.

The instrument landing system enables the pilot of an aircraft, by using instruments alone, to approach a runway in the right direction to a point, about 200ft up, from which he can see the airfield lighting. The aircraft is then at a safe gliding angle for landing.

Compared with previous methods, the system is claimed to have a more stable beam, which is not affected by reflections from ground buildings—a feature which eliminates "weaving" as the plane approaches the runway.

The use of transistors keeps maintenance costs down to a minimum, and reduces the number of valves required from 140 to 14, and experience has shown that the life of a transistor is approximately 10 times that of the valve which it replaces.

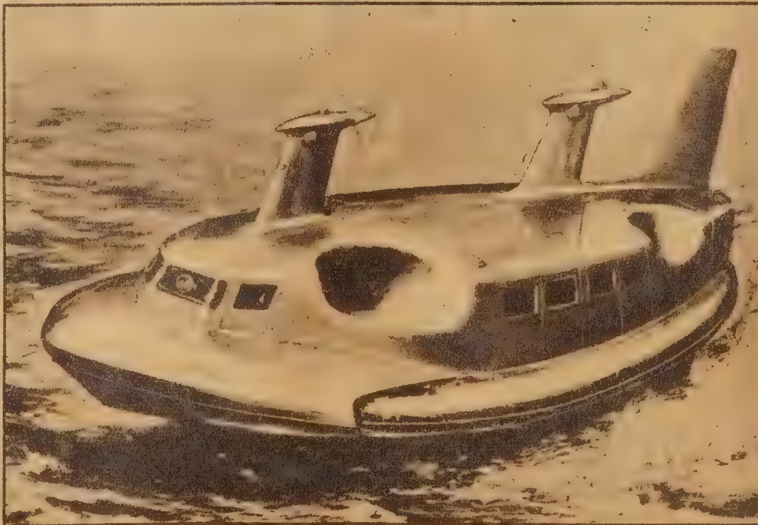
X-RAY PROOFING

A SPY-PROOF safe has been developed for the United States Navy to keep even the most top secret away from the most scientific thief.

Common non-government safes are proof against mechanical manipulation but a high-powered X-ray can "see" through steel plates and show the position of the tumblers and how they can be moved to open the safe.

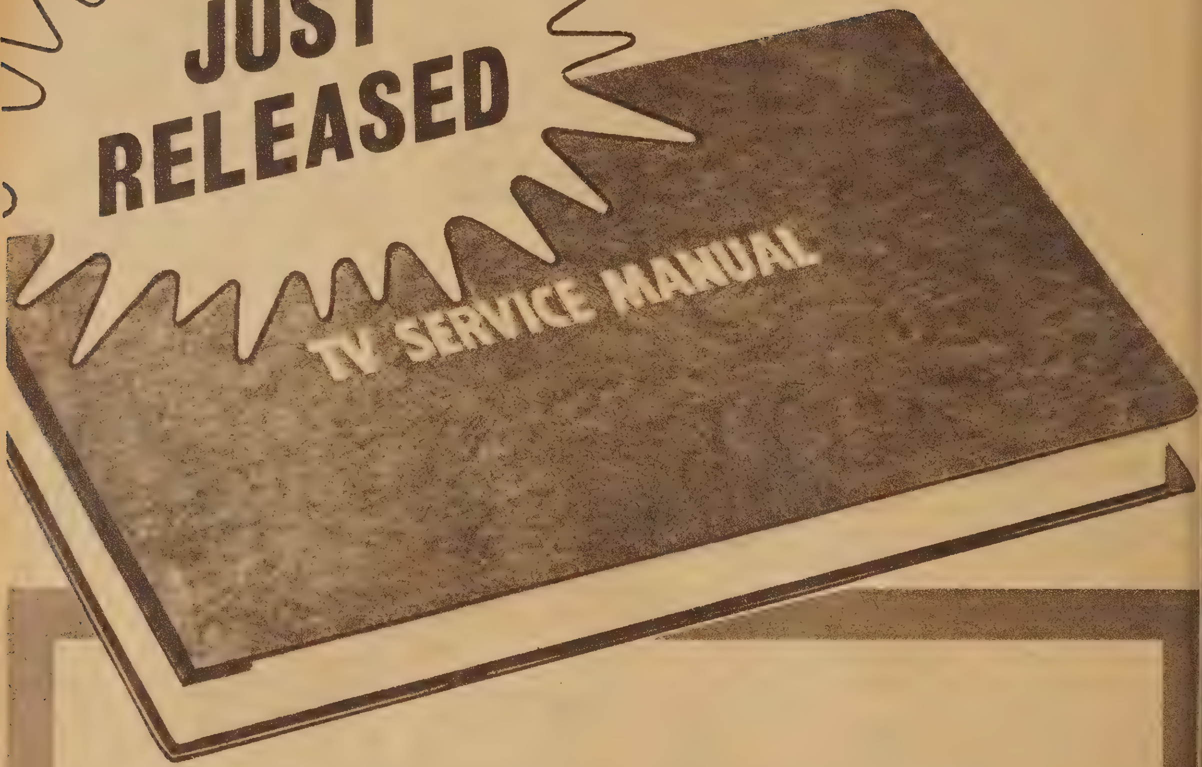
The new spy-proof job has lead shielding against X-ray, plastic tumblers which are transparent to the rays and an "armour" of steel balls. The balls make a succession of rings on X-ray film which overlies any pattern which might come through the shielding.

A COMMERCIAL HOVERCRAFT



Now that the experimental Hovercraft has proved itself, the makers are determined to push ahead with a commercial version. This drawing is of a 25-ton model at present under construction at Cowes. It is designed to carry 68 passengers or 10 tons of freight, and to cruise at 70 knots. Power comes from four Blackburn A129 gas turbines developing 3,000 h.p. which drive tow lifting fans and the two propellers shown. The new craft will be known as the SRN2.

JUST RELEASED



FIRST TV REPAIR MANUAL WHOLLY PREPARED FOR *TV SERVICEMEN*

1. Manual features circuit diagrams, chassis layout and voltage charts for all National brands of TV sets manufactured in Australia.
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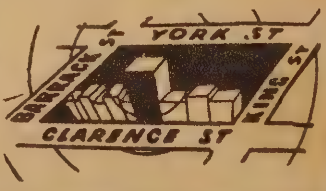


NEW CAMERA WITH WIDE SPEED RANGE

A NEW cinematograph camera can take pictures at a rate of from 400 frames per second up to 1,000,000 frames per second on standard 35 mm film either in black and white, or in colour.

The operation of the camera depends on the use of a combined electrical and optical system by means of which a special shutter is used to control the passage of the light by using ultra rapid electrical pulses.

When electrical conditions are changed, no light passes through the shutter, but when they are changed again, as for example by the production of a high-energy electrical pulse, then the light passes freely through both the filters and the shutter.

The camera also uses a rotating mirror which revolves at the rate of 100,000 revolutions per minute. This mirror directs the light rays to the film.

[Benson-Lehner Corporation, 11930 West Olympic Boulevard, Los Angeles 64, California, U.S.A.]

AUTOMATIC HUMAN HAND

THE development of an artificial hand greatly resembling a human hand has been described in a paper presented by R. Tomovic of Yugoslavia to the International Federation of Automatic Control conference in Moscow.

The device has been constructed from a human bone skeleton with elastic bands to open the hand in a relaxed position and wires operated by an electrical solenoid to close it.

This construction is enclosed in a rubber glove filled with sponge impregnated with carbon granules. A "sensing" current is produced proportional to gripping pressure and area and this "sensing" s fed back to the operating solenoid o limit the gripping pressure. The device is sensitive enough to hold a delicate wine glass.

AUTOMATIC CONTROL FOR WEIGHING SYSTEMS

BIG strides are being made in the development of automatic weighing ystems. They range from simple instalations to completely automatic systems which have complete control over the material and its processing.

These installations can also be lined o the production of documents, bills and abels and can be extended to the production of punched card or tape output n a form ready for feeding to computers.

One such system is based on a special photo-electric transducer (an electronic power transforming device) which can e attached to existing weighing equipment and which translates movement of he weigh-beam into a train of digital ulses. This digital train is "translated" into a voltage which not only controls he rate of feed but also stops feeding s soon as any pre-determined quantity as been reached.

Because the electrical and electronic ircuitry can be housed at a remote oint, the system can be operated in factories where materials of an inflammable r explosive nature are handled.

[Microcell, Blackwater Industrial state, Camberley, Surrey, England.]

MOULDED CIRCUITS

A NEW method of producing circuits for radio and television receivers and electronic equipment has been announced.

The circuits are made from rigid phenolformaldehyde mouldings with the circuit pattern produced as grooves and holes into which a nickel-phosphorus alloy is deposited by a chemical plating technique known as the Kanigen process.

All circuits, however complex, can be produced as channels and holes in the plastic base, the nickel-phosphorus metal being deposited after "masking" the remainder of the base with a chlorinated rubber paint. The completed circuit can be used as a chassis and there is no need for separate sockets for such components as valves or capacitors.

[Albright and Wilson, 1 Knightsbridge, London, SW1, England.]

AUTOMATIC FLOOR MAT

A NOVEL automatic floor mat for use in offices, factories and in the private home actively cleans the dirt off shoes.

The new mat consists essentially of an aluminium grille mounted on rubber and enclosed within a steel frame, which is built into the floor in the doorway. This aluminium grille contains a series of brushes filled with nylon filaments. These brushes are set in motion by means of an electric motor which comes into operation the instant that the mat is stepped on.

The nylon filament brushes the grille at a rate of several hundred strokes a minute and cleans the soles of the shoes with exceptional efficiency.

[Progressive Engineering Company, Holland, Michigan, U.S.A.]

CAR PARKING SYSTEM

DESIGNED to increase the effective car-parking space in large garages by about 30 per cent is a Swedish system employing moving plates.

The plates — in sizes large enough to take one, two or four cars — move on rails to release cars as their owners collect them and may be electrically or pneumatically powered. They stand about half an inch above the floor level so that cars may be readily driven off or on.

NEW PLASTIC MATERIAL

A NEW type of plastic material is claimed to give protection against the sun, rain, heat, wind, sea or chemicals.

It is the result of an exclusive process of laminating specially constructed Terylene fabrics between two layers of flexible PVC sheeting.

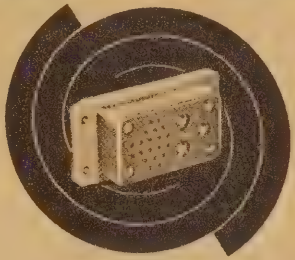
It is made in a wide range and by using different formulations of PVC and Terylene fabric it can be produced with physical properties to suit practically every requirement.

Among variations already being tried are special low-temperature grades, flame-resistant material, types with resistance to particular chemicals, and a range of heavyweight laminates.

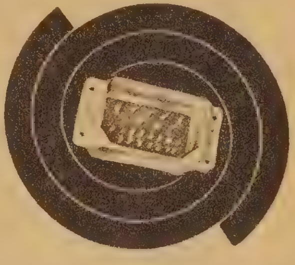
[Storeys, Lancaster, England.]

CANNON PLUGS

Rack/Panel/Chassis & Miniature

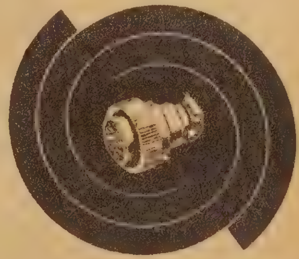


Standard DPD — strong aluminium shell for unit-plug-in applications. Wide range of contact voltage and amperages, including coaxials.



Miniature rack & panel type: shell protected 13 available insert arrangements: 5-amp, 10-amp and miniature coaxials: split shell.

D Sub-miniature rack/panel type: steel shell protected: all 5-amps, 9 to 50 contacts; flash. 1700v dc: junction shells, locking means, floating mounting holes: also hermetic seals.



K-Miniature; circular, aluminium shell protected; 3, 10, 20, 30, 38 contact arrangements; voltage up to 4000v ac. Also hermetic seals.

For information, write to Dept. RTH3,
CANNON PLUGS (AUST.) PTY. LTD.,
Cnr. Matthews Ave. & Hood St.,
Airport West, W.6, Melb., Victoria.

SINCE 1915

CANNON ELECTRIC

75 Watt 144 Mc Transmitter

For amateurs wishing to use high power on the two metre band (144 Mc.), here is a complete unit comprising transmitter, modulator and power supplies, housed in a shielded three-tier cabinet. The transmitter is capable of producing 100 watts of output. This month's article deals with the transmitter and power supply sections. Next month we will describe the modulator and construction of the cabinet.

By Vol Molesworth, M.A. (VK2VO)

The complete transmitter housed in a shielded cabinet. The top section is the transmitter proper, the centre section the modulator, and the bottom section the transmitter power supply. Built from wood, the cabinet is shielded by a lining of screen wire, effectively minimising TVI. Four large castors enable the cabinet to be manoeuvred for maintenance.

AMATEUR radio operators in Australia are authorised to use a transmitting power of 150 watts, measured at the plate of the valves delivering power to the aerial circuit.

In amateur parlance, "low power" refers to transmissions using an output of up to about 25 watts. This can be achieved with a single valve in the final and does not require very large power supplies.

50 WATTS AND UP

"High power" refers to transmissions with an output somewhere between 50 and 150 watts. This usually calls for two valves in the final, operating in a push-pull arrangement, with a fairly heavy power supply. A pair of 807s or 6146s will produce high power.

There does not appear to be any term in popular use to refer to transmissions using a power output between 25 and 50 watts. In all probability, no name is needed because, when extra power is sought, it usually takes the form of a fairly large increase.

The simple two metre transmitter described in the August issue of this magazine was a "low power" unit, delivering 18½ watts DC input to the final. To run "high power," an increase to somewhere around 75 watts was required.

There are two ways in which this could be done. One way would be to use the small transmitter as an "exciter" to drive a high-power final RF amplifier. The final would be built on a separate chassis, with its own power supply, and it would be link-coupled to the exciter by means of a length of coaxial cable.

With regard to modulation, we could either use the existing modulator in the low-power transmitter, and operate the final as a linear amplifier, or we could put in switching to by-pass the existing modulator, operate the final as a Class C RF amplifier, and build a new modulator delivering sufficient audio power to plate and screen modulate the final.

A number of amateurs on two metres use the first system. They have built their finals as "outboard" units, some running them as linear amplifiers, others as modulated RF amplifiers.

FOR AND AGAINST

The advantage of the low-level modulation system is that the exciter can be unplugged and used in the car as a low-power transmitter. The disadvantage is that the home station consists of a number of chassis, of various shapes and sizes, with separate power supplies.

Apart from the untidy appearance of wires running around the bench, the "outboard" system is more prone to RF feedback — a Frankenstein's monster at 144 Mc.

We decided to build the high-power rig as a self-contained unit in one cabinet, with the exciter and final stages all on one chassis, and their power supplies on another chassis.

The modulator, with its own power supply, is built on a third chassis, and the three chassis sit one on top of the other in a specially constructed cabinet, not unlike a three-drawer office filing cabinet.

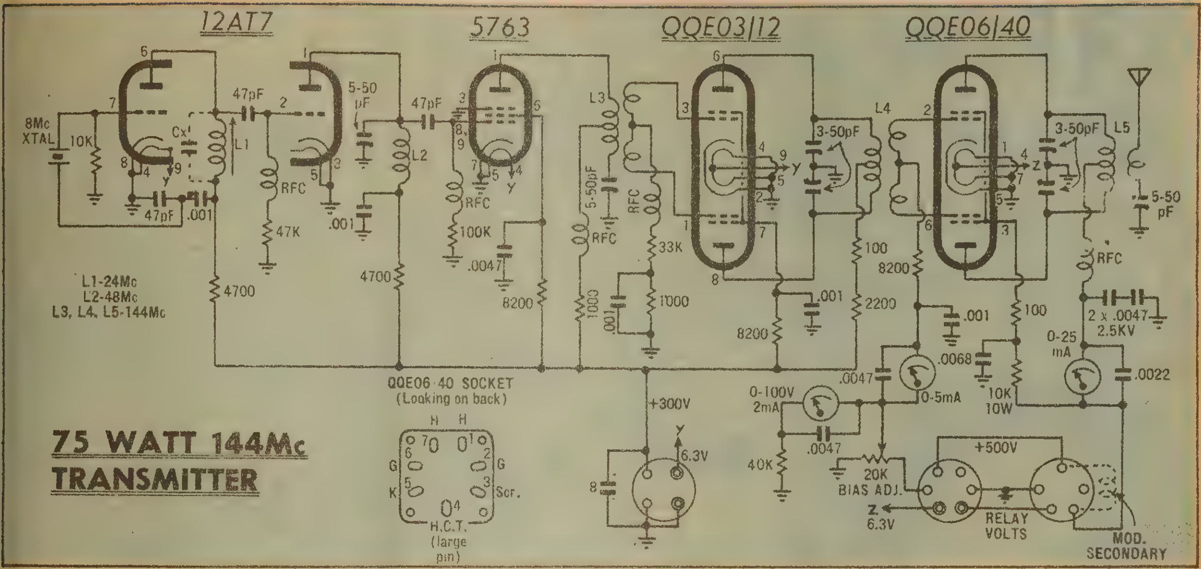
The finished appearance can be seen in the photograph. The cabinet itself is 37in high, 19½in wide, and 12¼in deep. Mounted on castors for easy movement about the shack, it stands exactly 39½in above the floor — a convenient height for armchair operation.

CABINET DETAILS

The cabinet is made of 1in cored timber. It contains two shelves, dividing the interior into three compartments. On the "top floor" is the transmitter chassis, in the middle compartment the modulator and, on the "ground floor" the power supply.

Each of these units is built on a standard 17in x 10in x 3in chassis, with an 18in x 12in aluminium front panel. The chassis slide into their compartments on angled aluminium runners.

CIRCUIT FEATURES 2 VHF TWIN TETRODES


12AT7
5763
QQE03/12
QQE06/40
8Mc XTAL
10K
Cx
47pF
L1
5-50 pF
47pF
L2
RFC
47K
.001
47pF
.001
100K
.0047
8200
4700
4700
L1-24Mc
L2-48Mc
L3, L4, L5-144Mc
L3
5-50pF
RFC
RFC
33K
1000
1000
.001
3-50pF
L4
100
8200
2200
.001
8200
.001
3-50pF
L5
5-50 pF
RFC
2 x .0047
2.5KV
100
0-25 mA
.0068
.0047
0-5mA
10K 10W
.0022
0-100V 2mA
.0047
40K
20K BIAS ADJ.
Z 6.3V
+500V
RELAY VOLTS
MOD. SECONDARY
+300V
Y 6.3V
8
QQE06 40 SOCKET (Looking on back)
H H
G G
K Scr.
H.C.T. (large pin)
75 WATT 144Mc TRANSMITTER

The first half of the 12AT7 functions as a harmonic oscillator and the second section as a doubler. The 5763 works as a tripler, delivering 144 Mc to the QQE03/12 which works as a straight through amplifier into the QQE06/40. Input to the final is approximately 75 watts.

Before the cabinet was screwed together, each sheet of timber was covered on one side with copper gauze wire, "spotted" with solder to help preserve its electrical conductivity. Both sides of the shelves were covered with this fine screen wire.

When the cabinet is put together, the interior surfaces make up three shielded compartments, each completely screened from the other.

When the three chassis are slid into place, and a "fly-screen" type door hung on the back, we have a totally shielded box. So much so that it is necessary to open the fly-screen door to pick up RF output from the tank circuit with the transistorised wavemeter (described last month) only a few feet away.

Sufficient clearance is left at the rear of each shelf to allow connecting cables to be plugged into the backs of the chassis.

FINISH

The outside of the cabinet was sandpapered, given two liberal doses of white undercoat, and then painted with a high-gloss grey enamel. The aluminium front panels of each unit were polished with steel wool, cleaned with spirit, and given a coat of quick-drying grey enamel. The finished cabinet is quite neat in appearance.

This month we shall describe the top and bottom sections of the unit — the transmitter proper, and its power supply. Next month we shall describe the modulator (which has its own power supply) and also give constructional details of the TVI-proof cabinet.

The first question to be settled was the choice of a valve for the high power final. It would have to be a twin tetrode for push-pull operation, with a high stage gain, showing little tendency to go into self-oscillation at very high frequencies.

PARTS LIST

1 chassis 17in. x 10in. x 3in.
1 front panel 18in. x 12in.
3 9-pin miniature sockets.
1 ceramic socket for QQE06/440.
1 2 mA meter (100 volt dial).
1 5 mA meter.
1 250 mA meter.
1 3/8in. slug tuned coil former.
1 4 pin socket.
1 5 pin socket.
1 6 pin socket.
1 8 Mc. crystal with holder to suit.
1 coaxial socket.

RESISTORS

2 x 100 ohm ½ watt.
2 x 1,000 ohm ½ watt.
1 x 2,200 ohm ½ watt.
2 x 4,700 ohm ½ watt.
3 x 8,200 ohm ½ watt.
1 x 10 K ½ watt.
1 x 33 K ½ watt.
1 x 40 K ½ watt.
1 x 47 K ½watt.
1 x 100 K ½ watt.
1 x 10 K 10 watt.
1 wirewound potentiometer 20 K ohms.

CAPACITORS

3 x 47 pF.
5 x .001.
1 x .0022.
3 x .0047.
2 x .0047 2.5 KV.
1 x .0068.
1 8 mfd. 600V. electrolytic.
2 butterfly capacitors, 3-50 pF. per section.
3 variable capacitors 5-50 pF.

VALVES

12AT7, 5763, QQE03/12, QQE06/40.

PARTS LIST FOR POWER SUPPLY.

1 chassis 17in. x 10in. x 3in.
1 front panel 18in. x 12in.
1 transformer 500 volts per side at 250 mA.
1 transformer 300 volts per side at 100 mA, 6.3 V, 5 V.
1 transformer 2 x 6.3 V.
1 transformer 2.5 V.
1 250 mA choke.
1 100 mA choke.
1 40 mA choke.
1 fuseholder and fuse.
1 banana socket.
1 6.3 dial lamp and holder.
1 3 pin power socket.
1 3 pin power plug and cord.
1 8 mfd, 1500V oil-filled capacitor.
2 16 mfd 600V electrolytic capacitors.
1 8 mfd 400V electrolytic capacitor.
1 50 K 10 W resistor.
1 1 megohm 1 watt resistor.
1 1000 ohm 1 watt resistor.
1 7,500 ohm 10 watt resistor.
2 ceramic 4 pin sockets.
1 ordinary 4 pin socket.
1 5 pin socket.
3 octal sockets.
3 relays to suit, normally open circuit.
Valves: 2 x 866A, 5R4GY, 6X5, VR75.

"PAYNECO"

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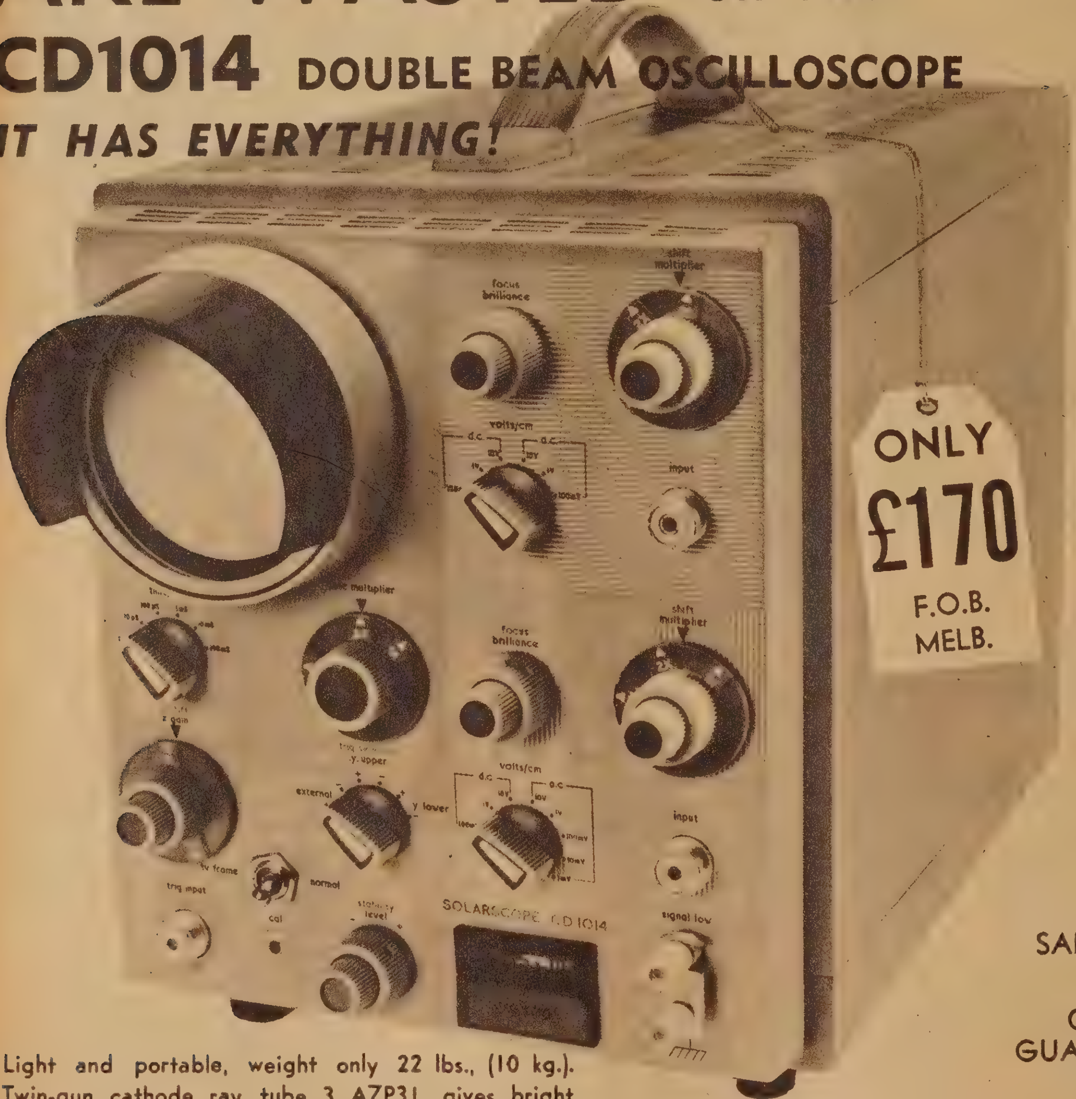
CD1014 DOUBLE BEAM OSCILLOSCOPE

IT HAS EVERYTHING!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- Wide range linear time base 1 μsec/cm—1 sec/cm, continuously variable.
- Velocity and amplitude measurements accurate to 5%.
- Y1 and Y2 DC — 5 Mc/s (3dB) at 100 mV/cm — 100 V/cm.
- 10 times X expansion continuously variable. X shift centres any portion of the trace.
- Y2 has additional integral pre-amplifier giving 1 mV/cm.
- T.V. frame sync separator.
- Mains frequency calibration square wave, ½ V pk-pk plus or minus 1%.
- 'Stability' and 'level' controls permit triggering from any selected point on a trigger waveform.
- Inputs can be 'floated' up to 500 V with respect to earth.
- New styling, functional grouping of controls, ease of handling and accessibility.
- Time base waveform available via cathode follower.
- High quality components throughout. Only two valve types used. Consumption 75 VA.

RONALD J. T. PAYNE
PTY. LTD.

385-389 BRIDGE ROAD, RICHMOND,
VICTORIA, AUSTRALIA
TELEPHONE: JB1416

Fortunately, a valve meeting these rejuirements has come on to the radio narket in recent years. It is a twin etrode with high stage gain and internal ieutralisation, with a hard glass envelope, and rigid internal construction. The Philips version is designated)QE06/40 and the Mullard version)QV06/40. We experimented with both nakes and obtained equal results.

In any twin tetrode the tendency to elf-oscillate is reduced, because by placng the two "halves" of the push-pull tage in a common envelope the inducances between the cathodes and screens ire reduced. In the "QQ" twin tetrodes he inductances are reduced even further y having a cathode and a screen comnon to both "halves" of the twin tetrode.

MOUNTING OPTIONAL

The 6/40 (for short) has the added advantage that it may be mounted either vertically or horizontally. The plate onnections are brought out through the op of the envelope, enabling the valve o be mounted horizontally on an upight plate, thereby shielding the grid nput leads (on the socket) from the plate utput leads.

The 6/40 is provided with a cathode f roughly rectangular cross-section.)nly the long, slightly convex, sides are oated with an emitting material, so hat the valve really has two cathodes nterconnected by the shorter sides of he rectangular body. The self-inducance of these short and wide "connectng strips" is so small that even at 500 Mc self-oscillation is neutralised.

Any tendency to oscillation is couneracted further by two small neutralising ondensers actually built into the valve. These are formed by the capacitance beween each plate lead and a short length f wire welded on to the opposite grid.

The manufacturers state that the 6/40 s self-neutralised to 500 Mc. It should ot, therefore, be necessary to provide ny external neutralisation at 144 Mc.

Some amateurs, however, have found t necessary to make up neutralising rods" from heavy gauge wire (even rass shim) and place them outside the alve parallel to the plates, cross-conected back to the grids at the socket.

We did not find this necessary. At ne stage, during testing, a pair of neutralising "rods" were made up and put in, but later they were taken out.

For the exciter section, we decided at first to try a circuit published overseas. This uses two 12AT7 miniature twin triodes, and a 2E26 octal power pentode. One half of the first 12AT7 is used as an overtone oscillator, the other half as a "tripler." Both halves of the second 12AT7 are paralleled as a "doubler," and the 2E26 is used to drive the high-power final.

While this is all right in theory, in practice we could not make it work out. The "Robert Dollar" oscillator worked quite well, producing 24 Mc. output from a crystal with an 8 Mc. fundamental, but the second half of the 12AT7, acting as a tripler, refused to produce sufficient drive at 72 Mc.

This stage was then rewired as a "doubler," and ample drive at 48 Mc. was obtained.

The second 12AT7, although now hard driven as a "tripler" from 48 Mc. to 144 Mc., still would not produce enough drive. Attributing this to the increased internal capacitance due to the paralleling of the two triodes, we substituted a 5763 miniature pentode. The problem was immediately overcome, ample output now being obtained from the plate of the 5763 at 144 Mc.

DRIVE PROBLEM

But our troubles were by no means over. The 2E26 has the advantage that its grid is below the chassis (on the socket) and its plate connection taken out through a top cap, which avoids RF feedback, but we found it would not produce enough output at 144 Mc to drive the high-power final.

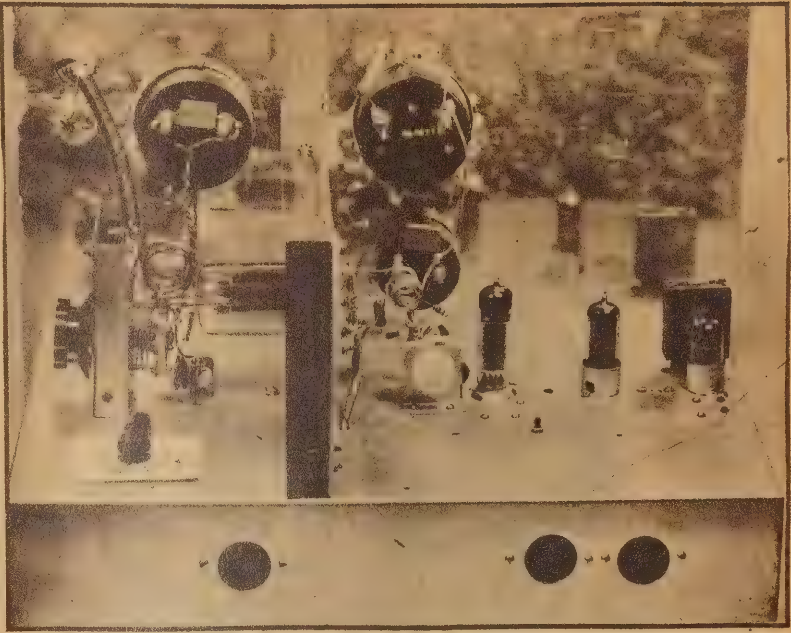
We decided, therefore, to revert to our ideas in the 18½ watt transmitter, and wired in a QQE03/12 twin tetrode as a push-pull driver.

The final line-up of valves is therefore a 12AT7, half overtone oscillator and half doubler, a 5763 tripler, and a QQE03/12, driving the QQE06/40.

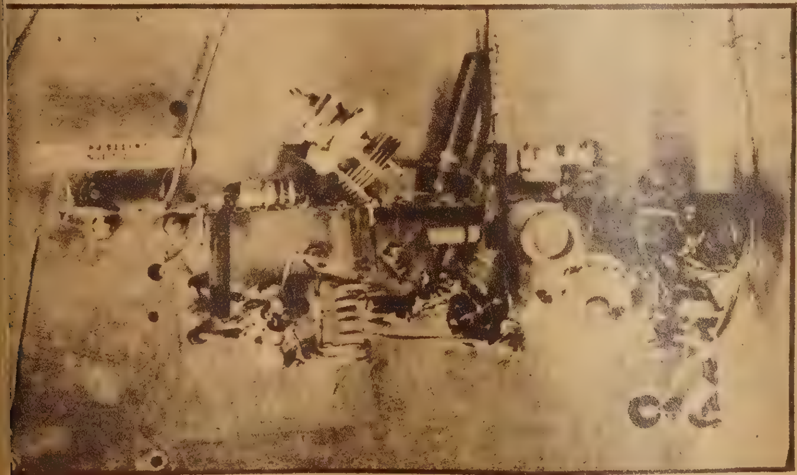
The main difference between the exciter section and the 18½ watt transmitter is that the former uses a 5763 as a tripler, whereas the latter used a 6AM5 as a doubler and followed it with a second 6AM5 as a straight-through amplifier.

Since the QQE03/12 is now being employed only as a driver, it does not

TRANSMITTER CHASSIS LAYOUT



On the extreme right is the 12AT7 with the crystal immediately behind it. Next is the 5763 tripler, and then the QQE03/12 straight driver. The QQE06/40 final is mounted on its side with the upright panel acting as a shield between input and output. The meters are: Top centre, bias voltage, lower centre, grid current; top left, final plate current.



A close-up of portion of the underchassis wiring. The 12AT7 socket, crystal socket, and coil L1 are on the extreme right. The 5763 socket is in the centre and the QQE03/12 on the left. Refer to the text for details of minor components.

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2N1426

AMALGAMATED WIRELESS VALVE CO. PTY. LTD.
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ieed itself to be driven quite so hard, nd the second 6AM5 is no longer necesary.

The transmitter is built on a standard 7in x 10in x 3in chassis. The front anel overlaps this by half an inch at ach side and at the bottom.

The only components mounted on the ront panel are three meters, a coaxial erial socket, and the screwdriver-adusted aerial trimmer condenser. The neters indicate grid drive to the final, late current "dip" in the final, and the egative bias voltage on the final. We sed directly calibrated dials, reading mA, 250 mA, and 100 volts, respecively.

PRE-SET ADJUSTMENTS

The tuning controls are NOT mounted n the front panel. There are good easons for this. Since the transmitter is rystal controlled, it should not be necesary to retune for maximum grid drive nd minimum plate "dip" every time the ransmitter is placed on the air. These uning adjustments are set initially, and hecked thereafter at periodic intervals. The tuning knobs are therefore kept beind the panel, where they cannot be ccidentally bumped off frequency, or "twiddled" by younger visitors to the hack.

Putting these controls on the front anel, moreover, would have meant ither deviating from a "straight line" ayout of the multiplying stages and the inal, or thinking up some fancy arrangenent of coupling, possibly with flexible r right-hand drives, between the varible condensers and knobs on the front anel.

Looking at the photograph of the rear f the transmitter, a vertical aluminium hield is seen about 6½in in from the eft. This divides the final and exciter ections. It also helps support the front anel, and supports the large ceramic ocket of the 6/40, which is mounted ertically.

The connections for this socket are iven with the circuit diagram. If you ave a 522 transmitter from disposals ources, the 832 sockets in it are the ame as the 6/40 socket.

A small vertical plate can be seen at he left hand side of the chassis. This upports the butterfly P.A. tuning capacior, to the fixed plates of which are oldered the large turns of the final tank" coil.

PLATE CONNECTIONS

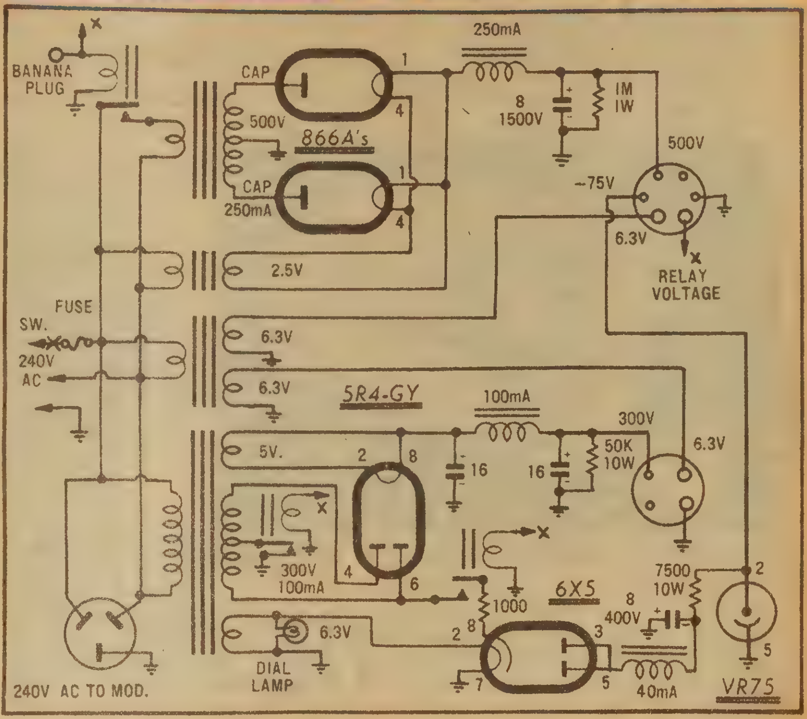
Short lengths of busbar connect each ide of this capacitor to a plate of the QE06/40. Small clips are used to nake good electrical connections to the rotruding plate pins.

This small vertical plate is also used s an anchor point for a three-tag strip. he aerial coupling coil is connected to he two insulated outside tags.

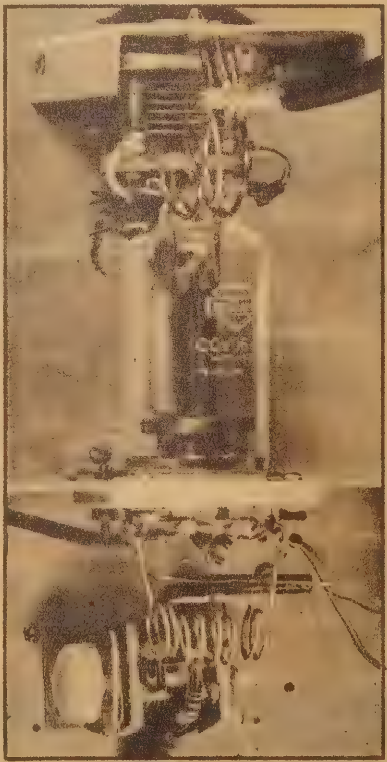
A short length of heavy duty 75 ohm oax. cable connects one end of the oupling link to the antenna socket, the ther end going to earth through the nall variable capacitor mounted imediately below the antenna socket on he front panel. This is the aerial "trimner" used to tune reactance out of the eedline to the antenna.

(Do not use the light duty quarter-inch oaxial cable here or you will find it ill get quite hot.)

HT AND BIAS SUPPLY CIRCUIT



The power supply is really three supplies on the one chassis. The 866As supply the 500 volts HT required by the final, the 5R4GY the 300 volts for the earlier stages, and the 6X5 and VR75 the bias for the final. Note the bleed resistors connected across the filter capacitors in the interest of safety.



Close-up of the final, showing how the QQE06/40 is mounted on the shield plate. Grid coils are underneath the socket, plate coil at the top of the picture.

A three-tag strip behind the P.A. tuning capacitor supports the RF choke and .0025 mfd 5 KV. capacitor associated with the high-tension supply to the centre of the tank coil. (We used a pair of .005 mfd 2.5 KV. disc ceramic condensers in series here.)

At the rear of the left hand compartment can be seen a hand-lettered scale reading 0-75 volts, with a pointer knob. This is a 20,000 ohm variable resistance in the negative bias voltage line, enabling any degree of bias to be placed on the final between these limits.

EARLY STAGES

Looking now at the right hand side of the dividing plate, we see the socket of the QQE06/40, the exciter tuning capacitor, QQE03/12, 5763, 12AT7, and 8 Mc. crystal, all lying in the same straight line.

The grid current meter and negative bias voltmeter are on this side of the shield, the P.A. current "dip" meter on the other.

The series-tuned output coil of the QQE03/12 is mounted above the chassis, on top of its tuning capacitor. There are two reasons for this.

Firstly, the input and output circuits of the QQE03/12 are both operating at the same frequency (144 Mc.), and it is desirable to place one circuit below the chassis and the other circuit above it to avoid RF feedback, which could turn the driver stage into a tuned-plate-tuned-grid oscillator.

Secondly, mounting the output coil here makes easy connection by means of link coupling to the grids of the QQE06/40, on the socket nearby.

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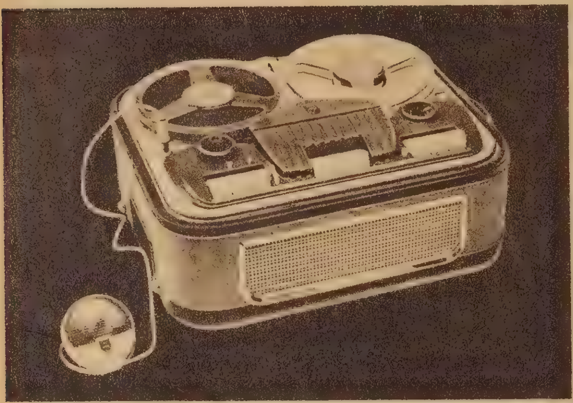

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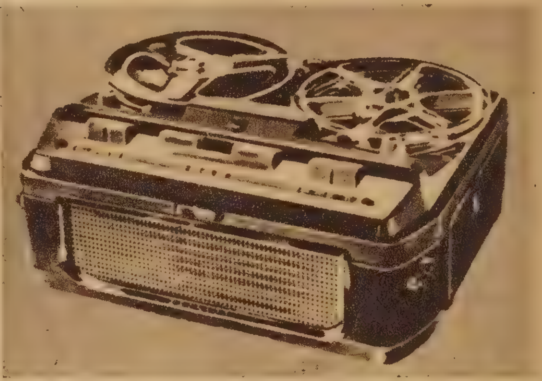

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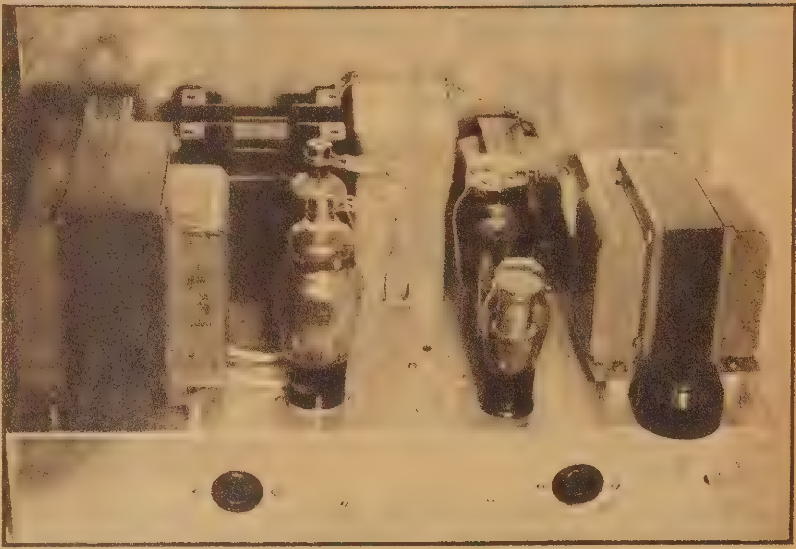
HT AND BIAS SUPPLY LAYOUT



At the extreme left is the 500 volt per side, 250 mA transformer which, with the 866As, forms the high voltage supply for the final. To the right can be seen the VR75 (nearest camera), the 6X5 bias rectifier, behind it and almost obscured, and the 5R4GY behind this again.

On the back of the chassis are three sockets, into which are plugged connecting cables from the power supply and the modulator. The socket at right is a four-pin type, bringing in filament and high tension supplies for the valves in the exciter section only.

Next to it is a six-pin type, bringing in filament supply for the final only, the 75 volt negative bias supply, a relay supply, and the unmodulated 500 volts DC supply.

The last two lines are taken to the five-pin socket at left, for connection to the modulator chassis below. Modulated H.T. is brought back through this socket for plate and screen modulation of the QQE06/40.

TESTING PROCEDURE

For testing and lining up the transmitter, the pins of the five-pin socket which go to and come from the secondary winding of the modulation transformer may be simply bridged across, and the modulator put aside.

While, at first glance, there may appear to be a considerable amount of waste space on the transmitter chassis, this is not really so.

It is essential that the valves should all lie in the same straight line, because RF does not take happily to turning corners at 144 Mc. The full 17 inches across the chassis is very definitely needed. The 10 inches depth could perhaps have been reduced but, apart from wanting to keep the three chassis in the cabinet all the same size, a clear space around the valve is very desirable for cooling purposes.

The QQE06/40 has a bulb temperature of 200 degrees centigrade and, when used at frequencies higher than 150 Mc. should be cooled with a stream of air from a blower motor. The "fly-screen" door allows air to circulate freely around the valves, while retaining shielding.

We also considered the possibility of building a narrow band frequency modulator as a future project. Amateurs are authorised to use N.B.F.M. at this frequency. There is sufficient room at the rear of the chassis to mount a small N.B.F.M. unit, without interfering with air circulation.

UNDER THE CHASSIS

Looking at the underneath of the chassis, on the far right is the 12AT7 oscillator and doubler. Above the valve socket is mounted the 24 Mc slug-tuned coil in the plate circuit of the first half of the valve while, below the socket, is the D.C.11-type crystal holder.

The two capacitors in the feedback network are wired above the other components associated with this stage, as it may be necessary to vary their values to ensure stable operation of the overtone oscillator. (This point was dealt with in the August issue article.)

Running across the chassis above the valve sockets are two tagstrips, one having 12 lugs and the other eight lugs. These are used to support two of the coils, and a number of resistors and bypass capacitors.

Between the 12AT7 and 5763 sockets is mounted the 5-50 pF variable capacitor used to tune the 48 Mc. coil. This coil is mounted vertically between the fixed plates of the capacitor and the fourth lug on the 12-lug strip. It is bypassed at this point by a .001 mfd disc ceramic capacitor back to the common earth point for the 12AT7.

A 47 pF capacitor is wired straight from the fixed plates to pin 9 of the 5763. The plate coil of this stage, which is series-tuned, is mounted between pin 1 of the socket and the tenth lug on the strip. The series tuning capacitor (5-50 pF) is mounted on a small bracket and is connected between this lug and earth.

This capacitor is mounted at an angle to allow adjustment of its moving plates without coming into contact with the 500 volts readily available at the six-pin socket a few inches behind it.

The grids of the QQE03/12 (pins 1 and 3) are inductively coupled to this coil.

The end of the 8-lug tagstrip supports the 10,000 ohm 10 watt resistor in the screen supply to the 6/40, and its .0068 mfd disc ceramic by-pass capacitor.

The oscillator coil (L1) is wound on a 3/8in slug-tuned former. It consists of 17 turns of 18 gauge enamel-covered wire, close-wound over 1in. We found it necessary to put a small capacitance across this coil in order to resonate it. This consists of a half-inch of twisted hook-up wire (Cx).

DOUBLER COIL

The 48 Mc coil (L2) consists of six turns of 18 gauge tinned copper wire, half an inch in diameter, spaced five-eighths of an inch.

The series-tuned coil (L3) consists of 4½ turns of the same wire, half an inch in diameter, spread over five-eighths of an inch.

The QQE03/12 grid coils are made of two turns of the same wire and dimensions, at each end of the 5763 plate coil.

Above the chassis, the plate coil of the QQE03/12 (L4) consists of four turns of 18 gauge wire, half an inch in diameter, spaced five-eighths of an inch, centre tapped. The links are the same as for the QQE03/12 grid coils.

The tank coil of the 6/40 (L5) consists of two turns of 16 gauge enamel-covered wire, 1in in diameter, spaced over 1in. The aerial coupling link consists of a single turn of the same gauge.

The RF chokes are wound with 15 turns of No. 30 gauge SWG wire, close-wound on high-value carbon ½ watt resistors.

Coming now to the actual operating conditions of the transmitter, the manufacturers of the 6/40 recommend that fixed bias of 80 volts be used. This is with a plate voltage of 750 volts.

BIAS DETAILS

Since the nearest voltage regulator tube is the VR75, we reduced the plate voltage to 500 volts. With 250 volts on the common screen, the plate current at resonance is 150 mA, giving a DC input of 75 watts.

By decreasing the negative bias to 60 volts, we were able to increase the DC input to 100 watts. But with the transmitter loaded into the antenna, we found that only a very small increase in signal strength was reported by listening stations when the higher power was used.

We decided to be content with 75 watts, and retain the full 75 volts of bias. We had a very good reason for doing this.

We could have operated the tube with no fixed bias supply at all, relying on the automatic bias generated by a 120 ohm resistor in the cathode and an 8200 ohm resistor in the grids to hold the 6/40 to its rated limits. But the drawback with this method is that, should the drive fail, plate current will soar to a high level, with almost certain damage to the valve.

The cost of a fixed bias supply will increase the initial cost of the transmitter, but will provide positive protection for the high power final. With 75 volts of

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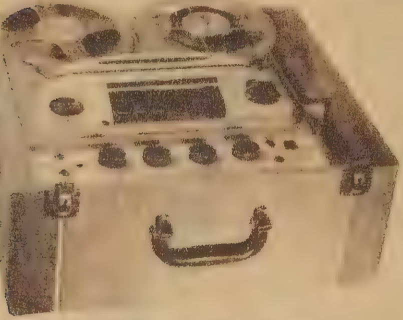

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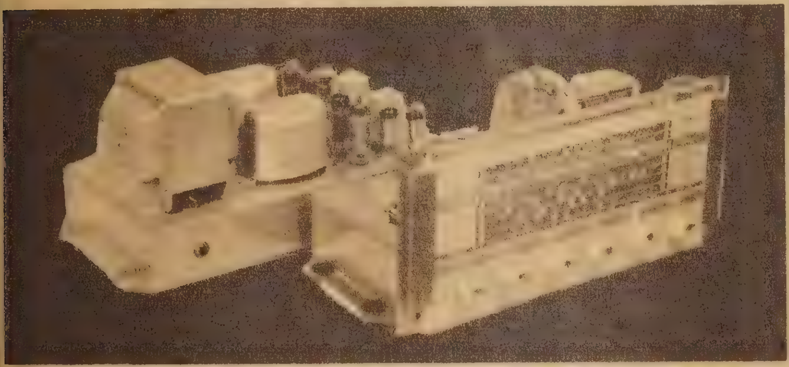

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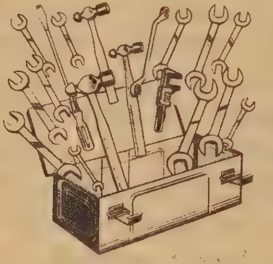

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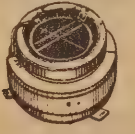

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Siemens 0-50 AC amps.

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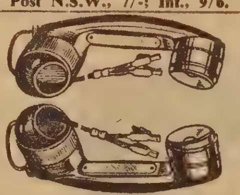

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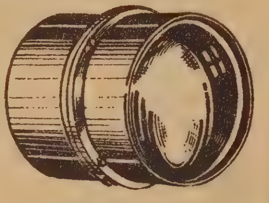

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3½in WITH CELL.

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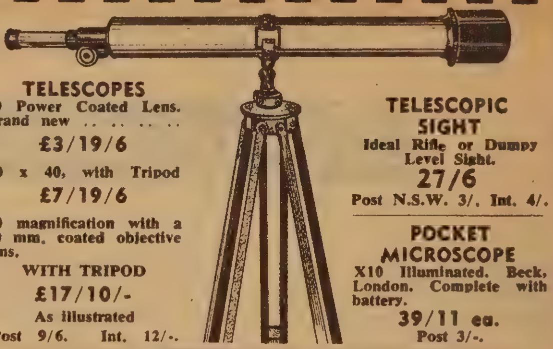

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30 Power Coated Lens. Brand new .. ..

£3/19/6

30 x 40, with Tripod

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60 magnification with a 60 mm. coated objective lens.

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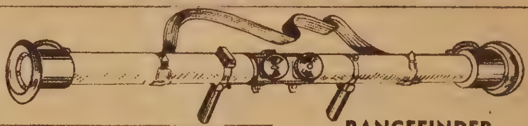

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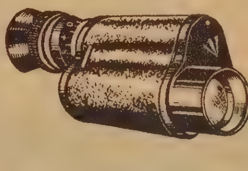
Barr and Stroud Tubular Type. 4 ft length MK. V.

£12/10/-



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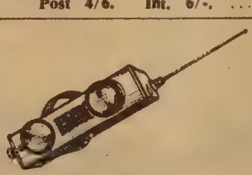

American WALKIE-TALKIE with all valves, crystals, coils and batteries.

Each **£7/19/6**

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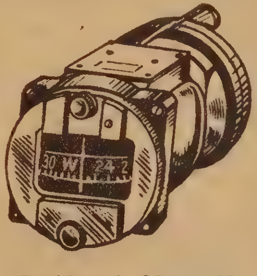

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Small ships. Pioneer American. Liquid Damped with Light. Also suit as car compass.

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RT24/APX2 or B/APX1 15 miniature seven-pin ceramic valve sockets and covers, trannies, etc.

45/- each

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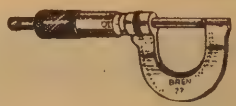
2-ton Dawn. New. Hand-operated. Complete with steel cable, £35. Freight payable at nearest attended railway station.



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0 to 1in, Starrett, Moore and Wright.

Perfect Order.
Post: 3/. **75/- ea.**

COMPLETE TRANSMITTER NO. 153

A.W.A. type J51050 comprising R.F. unit, power control and minor rectifier unit and main rectifier unit, with spares. 100 watt R.T. 300 watt C.W. Crystal controlled 2 to 20 megs, with power supply. 110 or 240 volt A.C. 50 cycle. New. Will transmit over 500-mile range daytime. World range night. Original cost £2,000. Heavy-duty wide band aerial included.

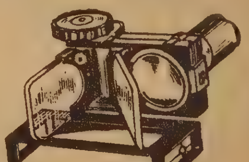
£125 COMPLETE

SECOND HAND £75 each

VALVES, NEW

6C4	7/6	9006	15/
6J6	15/	83	9/6
6AG5 ...	7/6	6J7G ..	11/6

Add postage.



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Contain these lenses:
1 lens 1in Focus, ½in diam.
1 Lens 1 11/16in Focus, 1¼in dia.
1 Air Spaced Lens, 1¼in diam.
1 Filter Lens, 1 Graticule.
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ASTRO COMPASS

(Boxed). New Condition.

£3/5/- each

Post. N.S.W., 5/; Int., 7/6.

DEITCH BROS.

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ias applied to the grids, failure of the rive to the QQE06/40 would result in late current being cut off.

Grid drive required is 3.4 milliamps 1.7 mA per section).

Power requirements for the transmit-er are 500 volts at 250 milliamps for he final, with 300 volts at 100 milliamps or the exciter section.

The 6/40 has two heaters which can e connected in series for 12.6 volt peration or in parallel for 6.3 volts. The eater current for 12.6 volts is 0.9 amps, or the lower voltage 1.8 amps.

Separate filament supplies should be sed for the exciter section and the final, ot only to meet the current drain, but o prevent any RF feedback occurring hrough a common heater line.

POWER SUPPLIES

We built two completely separate ower supplies on the one chassis. High ension for the final is obtained from a ransformer which has secondary tap-ings for 600 or 500 volts a side, and is ated at 250 milliamps.

A pair of 866As is used with a choke nput filter system consisting of a 250 nA choke and an 8 mfd 1500V. oil-illed capacitor. A one megohm 1 watt esistor is wired straight across the apacitor terminals to discharge it when he unit is switched off.

The centre tap of this transformer is arthed, the supply being switched on nd off by a relay in the active mains ead.

A heavy-duty 2.5 volts AC filament ransformer is used to heat the two mer-ury vapour rectifiers in parallel.

The exciter high tension is supplied y a transformer with a secondary pro-iding 300 volts at 100 mA. This is ectified with a 5R4GY valve, the DC utput being smoothed by a normal apacitor-input filter consisting of a 100 nA choke between two 16 mfd 600V lectrolytic capacitors.

A 50,000 ohm 20 watt bleed resistor ischarges the capacitors. The 5R4GY rectifier is heated by a 5 volt winding on the same transformer.

The negative bias supply is derived from one side of the 300 volt winding. The AC voltage is rectified in a half-wave rectifier circuit using a 6X5 valve with its plates joined together, rectification taking place between the indirectly heated cathode and the commoned plates.

A small choke and an 8 mfd 400V. electrolytic capacitor (connected back-to-front, with the positive pigtail earthed) are used to filter the DC output, which is then dropped in voltage through a 7500 ohm 10 watt resistor before being applied to the VR75 voltage regulator tube; this is also connected back-to-front (its plate earthed). This gives us 75 volts DC negative bias for the final.

Relays operating from a DC source are used to open the centre tap of the exciter high tension transformer and at the same time to break the connection between one side of the HT winding and the cathode of the 6X5. All the relays are wired to a banana socket on the front panel of the power supply.

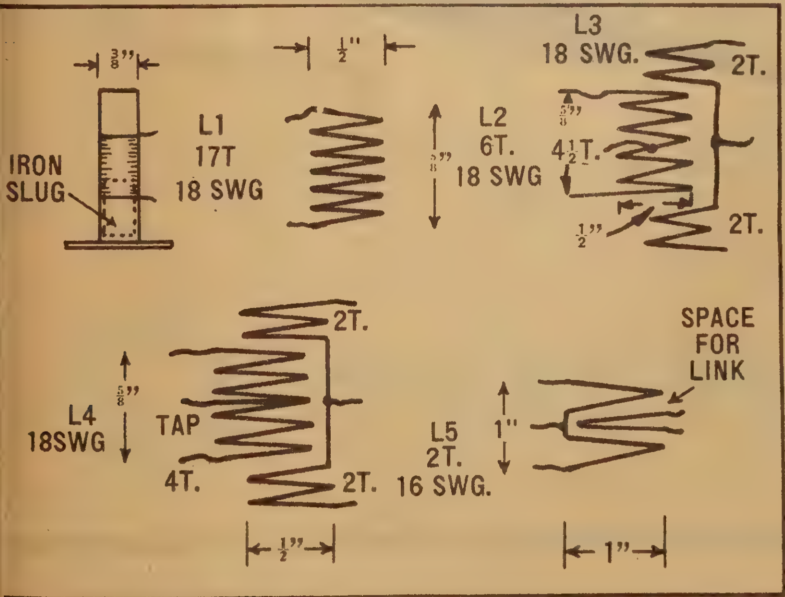
The relay-operating voltage is generated by a small DC supply, separate from the unit. This is plugged into whatever transmitter is to be put on the air. It consists of a transformer with three 6.3V windings in series, rectified by a metal bridge rectifier, and filtered with a 2,000 mfd 50V capacitor. A switch on the operating bench turns the relay supply on and off.

HEATER CIRCUITS

It will be seen that when the transmitter and modulator are switched on, all filament supplies come into operation. This includes 6.3V supplies to the heaters of all the valves, 2.5V. and 5V. supplies to the rectifiers. These remain on continually until the whole unit is switched off.

When the relay switch is closed, four separate relays operate in the unit. One applies 240 volts AC to the primary of

(Continued on Page 124)



Here are the physical details of the transmitter coils. With the exception of L1 they are self-supporting types. The specifications given should be close enough to allow final pruning by simply squeezing or expanding slightly as required.

The RADIOMASTER
RADIOGRAM CHASSIS . . .
A great performer on Radio and Records

STEREO MODEL S77 gives glorious three-dimensional sound that comes from everywhere in the room. Features include dual treble, bass and volume controls, also balance control. Broadcast and short-wave radio. Seven valves. Single chassis. Two speakers.
PRICE, £38/10/-

Stereo Model S66, 6 valves £31/10/-
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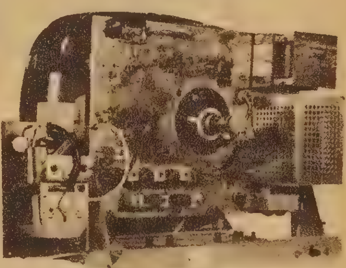
Packing included. Freight extra.

TELEVISION CHASSIS



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MSA1016

FROM THE SERVICEMAN WHO TELLS

I have heard it said that women are illogical creatures; further, that television signals are unpredictable in their behaviour. Combine the two and you have some idea of what I was up against just recently.

IT seems that a young lady, a physiotherapist by profession, walked into a local appliance store in response to an advertisement offering television sets "in new condition" from as low as 65 guineas, or something of that order.

She decided that she could afford some such figure but was wary of adding to it by way of outside aerial, installation costs, insurance and what-have-you.

Accordingly, she had a good look around, decided on one which appeared to give a good picture on all channels, ordered an indoor aerial to go with it and arranged for it to be delivered the following evening.

The set was duly delivered but results on the various channels did not appear to be as consistent as they had been in the shop. The man delivering the set suggested that she would be a lot better off with an outside aerial but the young lady was adamant.

KNEW WHAT SHE WANTED

She didn't want an outdoor aerial and she didn't mind experimenting with the one she had. Further, she wasn't fussy about all the channels. If she couldn't get one, there'd always be something to look at on the others.

Such is the enthusiasm — and the ignorance — of those who install television for the first time.

Naturally, she soon found out that you can't easily ignore any channel. There's a 33 p.c. chance that it is carrying the very film or the very feature that you want to see.

At that stage, one of her patients mentioned a nearby serviceman who had a certain limited skill in solving people's television problems. That is where I came into the picture and ultimately learned the story which I have just recounted.

In due course, I made my appearance in the apartment occupied by this very attractive — but very professional — young physiotherapist. Could I please assist with the problem?

It didn't take very long to verify that it was indeed, purely aerial trouble.

VARYING RESULTS

The picture on Channel 2 was very good, though the Fine Tuning needed to be swung hard over one way to make the best of it. On Channel 7, the picture was ueable but with a noticeable double immage about an inch to the right, and some "herringbone" patterns. On Channel 9, the picture was very weak, very noisy and with an almost "bas-relief" quality. (I hope that's how you spell it!)

This was with the aerial perched on top of the receiver. I tried rotating it, but without any benefit. It tended to weaken the two best channels and to move the picture bodily sideways on the screen, without doing much to assist Channel 9.

"I can't understand it," said the attractive one. "I have a friend not far from here with an aerial just like this one and it gets all the stations very well."

I explained that that was not at all an unusual circumstance; that television signals, particularly those on the higher frequency channels, were easily interfered with by materials within a building and close to the ground; that this caused them to be strong at one point and weak only a few feet away, in the most unpredictable fashion.

TRYING TO EXPLAIN

"In your case," I explained, "it would appear that the signals from Channel 9 are weak just where you happen to want to put your aerial. Signals from the other two channels are strong."

"But what about the ghost things on Channel 7?" she asked.

"That often happens, too," I went on, "because the aerial is not sufficiently directional to pick up only the signal coming from the station. It picks up a reflected signal from somewhere else and that produces the ghost.

"The wavy lines you see with some settings of the Fine Tune may be due to the aerial being so close to the set and picking up stray radiation from the receiver's internal circuits."

I could see that the attractive one was only partly with me but I felt that she was unimpressed by all my "mights" and "maybes." But that's the trouble with television signals. They're so invisible, so intangible, in the raw!

ON THE FLOOR

At this stage, I picked up the aerial and lowered it to the floor watching the picture on Channel 9. Miraculously it came good; Channel 2 was unaffected but Channel 7 had suffered, though still usable.

"You see," I said, "you could put the aerial there to watch Channel 9."

The lady wasn't impressed. Who ever heard of putting aerials on the floor?

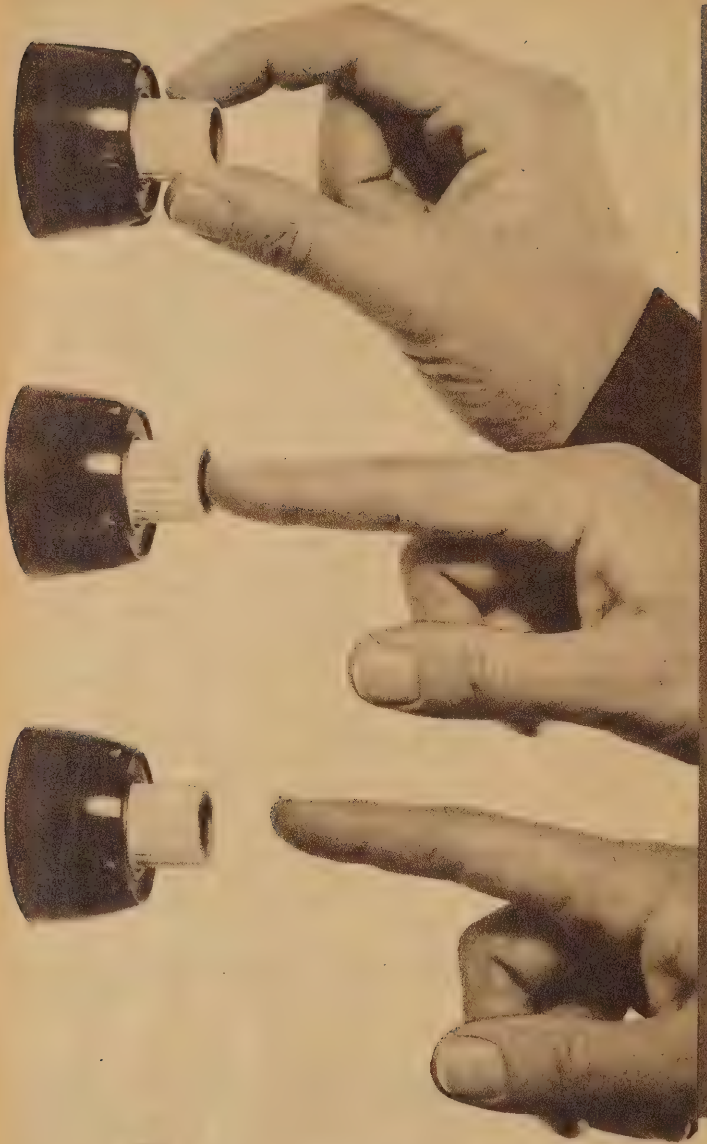
Nothing daunted, I grabbed a chair and put the aerial on it, alongside the set.

Channel 2, good; Channel 7, good and much as it was originally; Challen 9 good but only provided I still had my hand near one end of the aerial!

Acting on an inspiration, I shuffled the aerial a little to bring the end close to the metal beading around the front of the cabinet. Result? Good, usable pictures on all channels.

BOLTS INSTEAD OF FISH-HOOKS!

Small compartmented tins like this provide ideal containers for "radio" nuts, bolts and washers. But don't look for them in radio stores. The most likely source of supply is in suburban sports stores, where they are sold for a few shillings each, as fish-hook containers. Made from light gauge metal, they are securely welded and finished in grey hammertone.



PULL

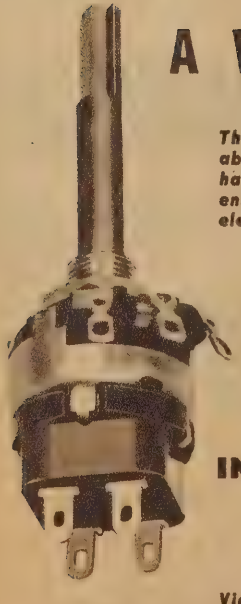
IT'S ON!

PUSH

IT'S OFF!

THE VOLUME NEVER ALTERS

A VITAL SALES FEATURE BY IRC



The new I R C Push-Pull control is available as a single or two-gang control, and has all the quality developments that have ensured I R C leadership in the field of electronic components.

More and more in the field of TV and radio, buyers are demanding convenience features. The new I R C Push-Pull switches meets this demand . . . now television receivers, radios or record players can be turned on or off without affecting volume, tone, brightness or other settings.

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msa1018

But no smile of satisfaction lit the ace across the room. Even I could ee that the chair was all wrong, standng in the suggested position, besides which someone may have wanted to sit on it.

After all, I suppose, that's what chairs are for.

Milady still felt that the aerial should rest on top of the set.

Then I had my big inspiration.

"We'll unscrew the legs of the receiver so that it sits directly on the carpet. Then we can stand the aerial on top of it and t will just be about right for the signals."

"That's lovely," she objected. "Everyone lies flat on the carpet to watch he pictures!"

But a little more of this and the alternatives had become clear, even to her essentially female mind.

ALTERNATIVES

(1) Instal an outside aerial? No, she didn't want to spend the money and she didn't own the property anyway!

(2) Go without one channel? No, there were too many features on it she wanted to see.

(3) Try other positions in the room for the set? No, there was only ONE POSITION and that was where she had t.

(4) Put the set flat on the floor with he aerial on top? Don't be ridiculous!

(5) Devise some way of supporting the aerial alongside the receiver?

And that was where she came up with he disarmingly simple answer. She had a little "stool thing" which apparently served multiple duties for the kitchen, for the telephone and for cleaning shoes.

All day the aerial could sit on the top of the TV set. In the evenings, she would bring out the little "stool thing" and put the aerial on it, "just the way you've shown me."

Oh, yes, she'd be careful not to tug the wires out of the back of the set, while so doing.

Women and television signals! But, brother, if ever I follow the Editor's example and break a leg, I know where I'll be heading for rehabilitation!

But speaking of the vagaries of radio signals, I had another experience recently, which may bear recounting. In this case it involved an ordinary tuner on the broadcast band.

The equipment concerned belonged—or should I say—belongs to a professional acquaintance and is a combination of a basic amplifier, control unit and a tuner built to the specifications of the "Radio, Television and Hobbies" Program Source.

ONE STATION POOR

The owner, who knows little of the echnicalities of radio, was immensely pleased with the whole outfit except hat its performance was poor on 2CH. With the gain control well advanced, and at a setting which caused every other station to roar in, 2CH had very ow apparent modulation and a heavy background hum.

Inspection showed that the equipment was earthed via the mains wiring and was connected to 15 feet of aerial pushed under the adjacent skirting board. While not impressive as a colector of signals, there was no gainsaying that all he other stations were at ample strength and I knew that 2CH was not notably weak in the particular area.

It looked like a curly one.

My first step was to ease the tuner forward and remove the underside cover, which exposed the wiring and the trimmers. A check with the multimeter showed that the voltages, while a trifle low overall, were not so low as to prejudice unduly the general performance.

In any case, they would not explain the modulation hum and poor performance on one station only.

A check on the aerial trimmer showed that it was a little off peak, possibly due to the different aerial but more likely due to its own mechanical instability. I found that it was sensitive, not merely to the rotation of the adjusting screw but to any pressure put on it by the driver.

DOCTORED TRIMMER

Before I could get an unambiguous peak, I had to remove the tension screw, slip the shank of the driver under the top plate and bend it into a more pronounced convex shape. With the screw replaced, it then produced a definite peak.

But while this picked up a little signal strength, 2CH was still notably weak and with a background of hum.

I had missed something. What was it?

Gazing pensively into the back of the equipment, I suddenly realised that the whole outfit was being fed from the mains via a plug-in type of line filter. The owner had installed it, so he told me, to cut out the "plops" caused by the refrigerator.

It was only the work of a moment to disconnect the filter and plug the whole equipment straight into the power point.

Result? 2CH had returned to full strength and the hum had vanished.

It seemed obvious that some random resonance effect in the line filter was acting as a trap circuit to signals from 2CH, without affecting those of adjacent stations.

The owner wasn't happy about the idea of omitting the filter, nor had I any particular yen to start delving into its entrails with a view to discovering the cause for its unusual behaviour.

But since the whole effect apparently had something to do with the mains as a signal source, I reasoned that a different aerial or earth system may correct the condition. I had another look at the aerial and noted that it ended very close to a second power point in the room.

Did the owner know anything about the wiring to that point?

NEW POWER POINT

It so happened that he did. The power point had been installed a few years back as an extra item and the electrician had run the wiring to it by removing the skirting board and slipping the tough rubber in at floor level just where the plaster ended.

The owner had subsequently pushed the aerial wire out of sight underneath the skirting board, so that it lay alongside the power wiring over the whole of its length. Lifting it out on to the carpet started to improve things.

THE ELECTROLYTIC THAT WASN'T

Dear Sir,

Enclosed is the remainder of a something-or-other which you may care to photograph for the information of other readers.

Do you know what it is or, at least what it was?

I asked an Albury radio dealer the above question and he said,

"It looks like an electrolytic capacitor."

"Well," said I, "that is exactly what I thought, but now have a look at my hands and my face."

I was in too much pain to worry about having pictures taken for you, but that "electrolytic capacitor" turned out to be a DETONATOR.

The radio into which I had wired it did not suffer a bit but after a fortnight, I am still picking pieces of aluminium out of my skin. The first one was from the edge of my eyelid.

Where did I get the detonator? From the effects of a radio serviceman who died some time ago.

Yours faithfully, A.C.W.G.

A E G I S

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STEREO & HI-FI UNITS

NEW AEGIS ULTRA-LINEAR Integrated STEREO SIX-88 Amplifier (illus. above) £79/17/6

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AEGIS Fidelity Radio Tuner Mark I £35

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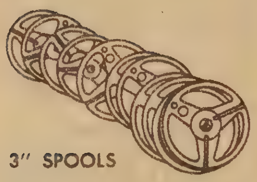
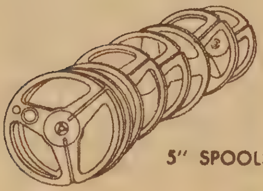
Because it is made from the finest materials using the most up-to-date processing techiques and under the strictest quality control, Rolatape embodies **all** the features to be sought in a premium-quality tape. These include consistency of output, extended frequency range, negligible distortion and low signal-to-noise level.

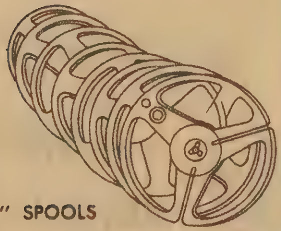
Rolatape is available on a range of standard spool sizes and in lengths from 225 to 3,600 feet.

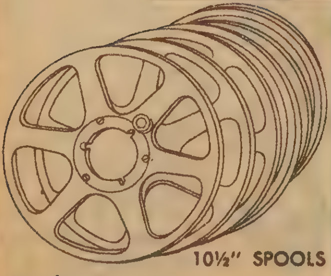
Two types of Premium-Quality Rolatape are currently available — the standard 1½ mil PVC-based tape used for most recording applications, and the 1 mil Polyester base which provides 50% more recording time per reel.

If you always insist on the best, insist on Rolatape — the tape with the famous name. It's the recording tape which will perform beyond your highest expectations.


3" SPOOLS


5" SPOOLS


7" SPOOLS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Drawing it up over the curtain rail ade them better still, though the aerial ire didn't look particularly elegant in ither position. It seemed as though e owner was faced with the task of etting an aerial to the tuner via the avity wall or by some other "invisle" route.

Just then my attention was drawn to small knot hole in the polished wood oor, behind the cabinet and leading own, presumably, into space under e house.

Out of curiosity, I poked the free end f the aerial wire into the hole and tarted feeding it down. Reception improved with every foot that disappeared.

XPLANATION

It wasn't hard to guess what was happening. Signal was being picked up by e mains wiring and by the run back the local "earth" point. It was being d via the amplifier chassis system to e "earthy end" of the aerial primary inding.

The active end of the primary was ow being returned to true earth by he capacitance of the aerial wire lying nderneath the house. In other words, e were using the aerial primary back-front.

Having no personal desire to crawl round under another man's house on cold winter's evening, I suggested that he owner could try an actual earth conection to a water pipe nearby or stringng the aerial wire along the bearers nder the house as a kind of "counteroise."

Frankly, I'll be surprised if he does ither. My tip is that the aerial wire vill spend the next few years exactly here I put it.

And why not? It works fine!

On the previous page is set out a etter which reached me via the Technical Editor a few days back. I suggest ou read it and inwardly digest, paricularly in view of the publicity which as been given lately to people keeping hells and hand grenades as war "souenirs."

I wonder whether the younger generaion of readers is aware of the fact that ome wartime radio equipment, which as since been sold through disposals, lid contain an explosive charge? The dea was that the operator could set ff this charge by depressing a suitably rotected switch, to prevent the equipnent falling intact into enemy hands.

WRECKING CHARGE

The charge was sufficiently strong to vreck the interior of the equipment, o prejudice the enemy's chances of vorking out design details and, in paricular, the exact operating frequencies.

While I was naturally aware of the rovision, I personally had little to do vith disposals gear after the war. However, on receipt of the letter, I did talk o a couple of acquaintances in the usiness seeking further information.

I found their ideas surprisingly hazy nd it is possible that someone, who nay chance to read this par, will be ble to put us straight.

INFORMANT NO. 1 said he knew hat detonators were included in I.F.F. quipment but he claimed that original pecifications for certain other items lefinitely called for the inclusion of letonators. Whether these were included n actual production or in the field, he ad no way of knowing.

INFORMANT NO. 2 said that detonators were included, to his knowledge, only in I.F.F. equipment. However, these were always "de-loused" before release to disposals dealers. He had never encountered detonators in situ, though he had seen them separately; they were about the size of a modern pigtail type 8mfd electrolytic.

INFORMANT NO. 3 said that plenty of I.F.F. sets had reached him with detonators still in position, Government inspectors apparently having assumed that, because sample equipment had been "de-loused," they had all been so treated. The detonators, which he had personally removed, had been about 6 inches long and of about ½-inch diameter.

Against this, the one encountered by our correspondent is described in the following terms and I quote:

"It is a small aluminium cylinder, approximately ¼-inch in diameter and between 1¼ and 1½ inches long originally. As it stands, one end has been blown out.

DESCRIPTION

"The other end is crimped on to a rubber bung from which two leads emerge, coloured red and yellow. They are plastic insulated single wire, about 26 gauge. To the red one is clamped a small metal disc on which the figure 3 is stamped.

"This latter and the twin solid conductors are the two most likely warning signs that it is not a regular radio component."

Well there it is. Two questions remain to be answered.

(1) Of the Australian-British-American equipment which has appeared on the local disposals market, what items included detonators?

(2) What forms did these detonators take? Evidence above suggests at least three different sizes.

To all this I can add only one remark — perhaps from a typically serviceman's point of view.

Even supposing one accepted an unbranded item as an electrolytic capacitor, how would one go about using it?

Without knowing its capacitance, and more particularly its voltage rating. I wouldn't be game to connect it into a high tension circuit. In possibly blowing up, it could do more damage than its own worth to other components.

DOUBTFUL VALUE

A cathode circuit would be a safer place, but then, the capacitance rating would be quite inadequate.

In short, there is hazard enough in using any kind of foil capacitor old enough to have come from wartime equipment, let alone one that is unbranded.

It's rather like finding a bottle of liquid on the dump and setting about to drink it, so it won't go to waste!

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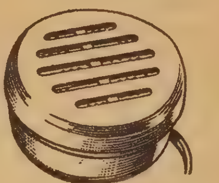

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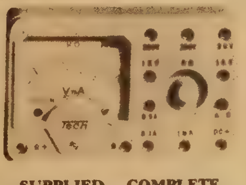

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EK32	6/9
6SA7GT	9/6
6SH7	5/6
15G	4/
1P5G	2/6
1C7G	3/
1K5G	2/6
1M5G	3/
1K7G	3/
1L5	9/6
6C8G	5/
6SS7	8/6
6H6	2/6
6H6GT	2/6
6K7GT	7/9
6U7G	5/
6J7G	5/
7C7	3/6
78	7/6
EL32	10/6
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A COURSE IN TELEVISION

PART 36—HORIZONTAL OUTPUT STAGE

This instalment of our television course is devoted to a discussion of a typical horizontal output stage in a modern television receiver. The scanning sequence is explained, together with the operation of the damper diode, B-plus boost circuit and the EHT rectifier.

IN earlier instalments, we discussed the nature and the generation of sawtooth waveforms and their synchronisation with the vertical (or frame) and horizontal (or line) pulses radiated by the transmitter.

These sawtooth waveforms having frequencies respectively of 50 and 15,625 cps (for the Australian system) are applied as drive signals to the vertical and horizontal deflection power amplifier stages whose output current, in turn, produces the requisite deflection of the scanning beam.

Part 35 of this series was devoted to a general discussion of these output stages and it was mentioned that the horizontal output stage, in particular, had been developed far beyond the concept of a simple power amplifier. Its operation is now closely dependant on what is known as the "damper" or "efficency" diode, besides which EHT and "Boost" voltages are developed as a by-product of its fundamental role.

In general, the horizontal output stages in all modern television receivers conform to the same basic pattern but there are naturally many variations in circuit detail, which have to be allowed for, when considering individual designs.

TRICKY SUBJECT

Perhaps the simplest approach, to what is admittedly a rather tricky subject, is to examine one quite typical circuit, making comment on the various aspects of its operation, while progressing from input to output.

A suitably typical circuit is shown in figure 194, being that of a "90-degree" horizontal deflection system for a receiver described some time ago in these columns. It differs only in detail from 70 to 110-degree circuits, the chief differences being in the physical design and ratings of the various components.

Input voltage to the grid is shown as a rather mis-shapen sawtooth, which will normally be locked to a frequency of 15,625 cps. The irregularity in shape is not a drawing error but indicates, fairly closely, the waveform to be expected at this point.

Most receiver circuits carry similar information and, when checking the performance of individual receivers on a CRO, the waveform should be compared with the specification rather than with a geometric ideal. The reason for this remark will become apparent later.

The amplitude of the signal drive voltage to the grid is no less important than the waveform and, once again, information about the peak-to-peak value is normally carried on individual schematic circuits.

The signal amplitude is normally made sufficient to drive the horizontal output value well into grid current so that, in this respect at least, its operation resembles that of a class C amplifier.

BIAS SOURCE

On the positive-going signal peak, the grid coupling capacitor—usually about .001 mfd—charges rapidly through the comparatively low resistance grid-cathode conduction path.

Over the remainder of the signal excursion, where grid current is not flowing, the coupling capacitor is free to discharge but the only available path is via the grid return resistor; this is normally about 1.0 meg—a comparatively high value.

Because of the rapid charge and slow discharge, a potential is stored across the coupling capacitor exceeding the cut-off bias of the output valve. The valve thus remains cut off over a substantial portion of the cycle, with a burst of plate current during each positive-going peak.

This being the case, the shape of the negative peak is unimportant, since it can have no influence on the output circuit, furthermore, the flow of grid current, by reason of the loading on the drive source, tends to round off the positive-going peak. Hence the earlier remark about the waveshape.

The amount of drive to the grid of the horizontal output valve is fairly critical, having a marked effect upon the linearity of the horizontal scan.

As a rule, there is no great margin of drive available from the average sawtooth oscillator, but, in any case, the circuit configuration is arranged to secure the right order of drive, leaving only a small margin for adjustment.

DRIVE CONTROL

Because of the grid current flow and the high frequency components of the sawtooth waveform, a potentiometer system is not usually considered suitable for a horizontal drive control.

The method shown in the specimen circuit is more typical. Here a variable compression type capacitor is connected between grid and earth.

With the capacitor at minimum setting, there is very little effect on the drive circuit and substantially the whole of the drive voltage is applied to the grid. When the capacitor is adjusted to its maximum value, a capacitive divider is created by which the drive voltage is reduced to about 80 per cent of its former value, without deterioration of waveshape.

Of the other components in the grid circuit, the return resistor has a minor influence on valve operating conditions, while the 47-ohm resistor is a grid "stopper," frequently included as a precaution against spurious instability.

SPECIAL VALVE

The horizontal output valve is normally specially designed for the job, having a very high transconductance, the capacity to handle high standing and peak plate current and a top-cap type plate connection, as a precaution against flashover with very high peak plate voltages.

In fact, many valves designed specially for horizontal output service in television receivers, make excellent medium-powered class-C amplifiers in transmitters.

In the cathode circuit, the resistor is intended mainly to provide some protection for the valve in the event of a drive failure, though it does have some effect on the average plate current and output waveform.

The series screen circuit also affords some protection, though the choice of components also affects the normal operating conditions.

The plate of the valve connects to a tapping on the horizontal output transformer.

As explained in an earlier article, this

ABOUT THIS COURSE:—

BECAUSE of staff changes, we had to suspend the preparation and publication of this special "Course in Television." However, we have had so many requests for its resumption, that we have decided to present additional instalments whenever the opportunity presents itself.

For the most part, each instalment is self-contained and deals with a separate aspect of receiver design. They should thus be useful as individual articles, even though the complete series may not be to hand.

At the time of writing the following issues in which instalments appeared are still available:

1956; May to November inclusive. 1957; January, August, September, October, December. 1958 and 1959: All issues carrying the course.

tter component is normally wound, in e manner of an RF "honeycomb" inictor, on an iron-dust or ferrite core. his method of construction is adopted suit the range of harmonics encountred in the horizontal output circuit, as ell as securing a natural resonance well ɔove the nominal operating frequency f 15,625 cps.

The voltage and current developed ross portion of the winding is fed to e horizontal deflection coils in the yoke ound the neck of the picture tube, to oduce the required beam deflection. It possible, by these means, to secure a iitable impedance match between the ource of deflection energy and the oad" presented by the yoke coils. But ore of this later.

HT CIRCUIT

And now for the first complication. here is no metallic circuit between the late of the horizontal output valve and e HT line. Its current has to flow rough an additional series diode, as ell as part of the transformer winding d a couple of small inductors.

Tracing it through, electrons flow om earth, through the bias resistor the cathode of the horizontal output valve, across the valve to its plate, rough portion of the transformer winding to the cathode of the "damper" or fficiency" diode, across the diode to ate, thence through the small inductors the B-plus line.

Like the horizontal output valve, the iode must be capable of passing high eak and standing currents, must present w series resistance when conducting, d be capable of withstanding high peak oltages.

In particular, there must be a very fective insulation between the heater nd cathode, since the former is norially at near earth potential while the tter is subject to peak voltages developed across portion of the horizontal itput transformer.

Imagine, now, a cycle of events, beginning with the horizontal output valve rawing low instantaneous current, with nall residual field in the transformer indings and with the scanning spot at bout centre screen, being subject to particular deflecting influence.

IGNAL ACTION

At this juncture, a positive-going sigal becomes apparent at the grid of the orizontal output valve, causing a progressive rise in plate current. This rising plate current builds a magnetic field ound the windings and core of the orizontal output transformer, inducing orresponding voltage and current in all ctions of the winding.

The movement of current, voltage and eld is communicated to the windings in e picture tube deflection yoke and, suming correct phase relationships, ould cause the scanning beam to move om centre towards the right-hand edge the screen.

The movement will continue for as ng as the plate current continues to se, while the rate of movement will obously be related to the rate or period the rise.

In fact, the plate current of the horintal output valve will—or should—ntinue to rise until the peak of the wtooth waveform is reached, at which point the grid is suddenly swung negative, cutting off the plate current completely.

A TYPICAL LINE OUTPUT STAGE

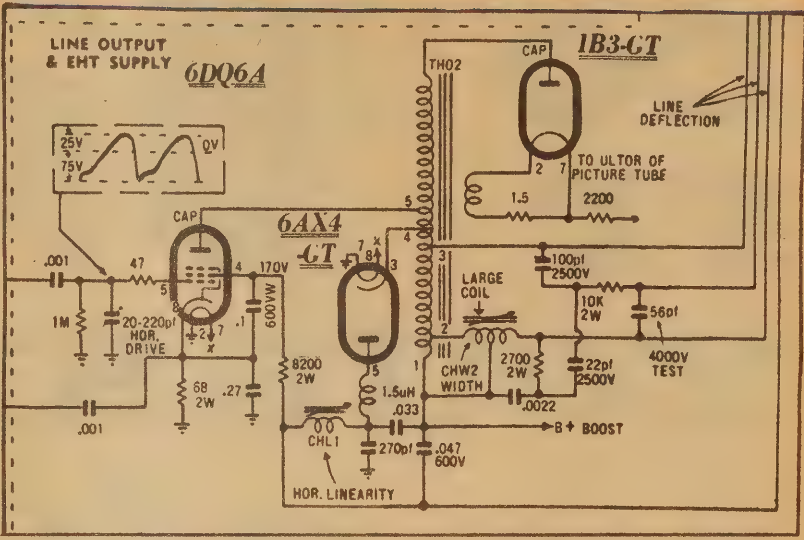

Figure 194: A typical horizontal output stage, actually from the R, TV & H 90-degree receiver. The electrical circuit is much the same for 110-degree receivers, but the components are more critical in design and the power requirements somewhat greater. Conversely, 70-degree are simpler and handle less peak power.

When this happens the magnetic field collapses, induces a reverse current through the windings in so doing and, as with any inductor in similar circumstances, builds a field of the opposite polarity.

MOVEMENT TO RIGHT

In building, the original field served to move the scanning beam towards the extreme right of the screen. In collapsing, the same field moves the scanning beam back to centre and, by continuing the movement to build a new, reverse field, it carries the beam towards the left-hand side of the screen.

The rate at which the field thus collapses and rebuilds is governed by the resonance characteristics of the total output circuit. This involves the entire horizontal output transformer, the yoke windings connected to it and any series and shunt capacitances which may be present.

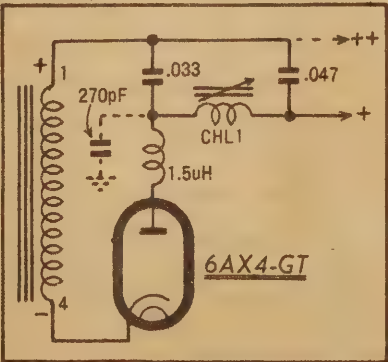

Figure 195: Here is the damper diode circuit extracted from figure 194 and rearranged to show more clearly how the charge voltage adds to B-plus to produce B-plus boost.

Designers aim at getting this natural resonance quite high, so that the retrace action of the beam from right to left will occupy as little time as possible. A typical figure for this resonance would be 70 kc.

Were no other influences brought to bear, the field would simply continue to collapse and rebuild in the manner of a damped oscillation. The scanning beam, as a result, would oscillate in similar fashion, while graduly reverting to the centre of the screen, to await further activation from the horizontal output valve.

In fact, this does not happen. To be sure, the field collapses suddenly, as described, and reforms in the reverse direction, effecting the retrace action. The output valve is completely cut off meanwhile, and the damper diode is virtually open circuited, since reversal of the field and generation of the resultant back EMF makes the diode cathode highly positive with respect to its plate.

DAMPER ACTION

But, when the field tries to reverse again, for its second half-cycle of damped oscillation, the reversing EMF puts the damper diode cathode at a potential negative with respect to its plate. The diode immediately begins to conduct, imposing loading or "damping" upon the oscillatory circuit.

In our specimen circuit, the portion involving the damper diode is the transformer winding between connections 1 and 4, the diode itself, the two small inductors and three capacitors. We can make the operation of the components easier to follow by extracting and rearranging them without, however, changing any of the electrical connections. See figure 195.

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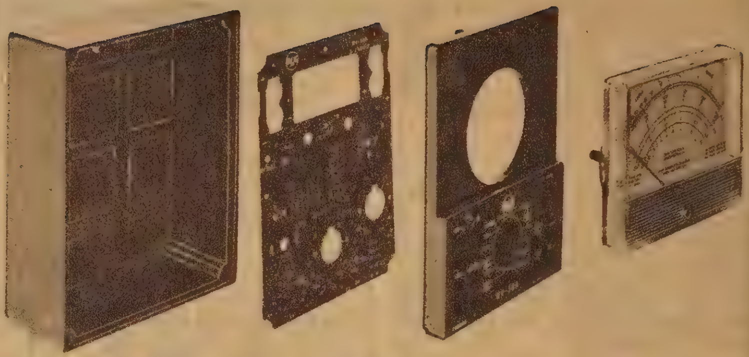

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It is easy to see that, during the initial flyback period, none of the components will be operative, because the diode, which is in series with them, is non-conductive, and is a virtual open circuit.

However, on the second half-cycle of the damped oscillation, connection 1 on the transformer becomes positive with respect to connection 4 and the conditions obtain as marked.

The diode will conduct and current will flow through it and into the .033 and .047 mfd capacitors.

Thus, instead of the field collapsing as a further half-cycle of high-frequency oscillation, it suddenly finds substantial extra capacitance "switched" into circuit by the diode. The field thus collapses at a much slower rate, as its energy is diverted into the two relatively large capacitors.

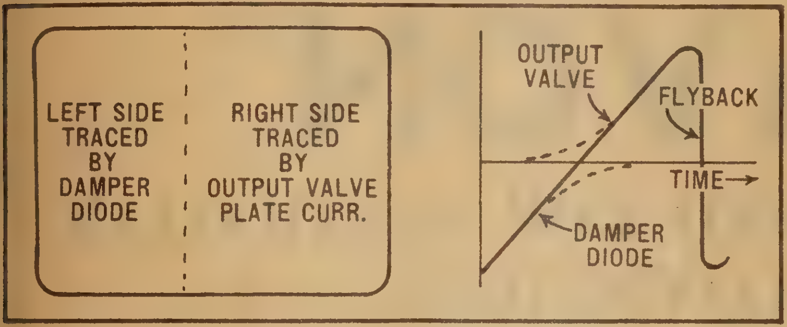
LEFT SIDE TRACED BY DAMPER DIODE
RIGHT SIDE TRACED BY OUTPUT VALVE PLATE CURR.
OUTPUT VALVE
FLYBACK
TIME
DAMPER DIODE

Figure 196: These diagrams show how the currents of damper diode and horizontal output valve combine to produce the complete left-right scan.

It is obvious enough that, during this period of conduction and charge, the diode, inductors and capacitors form a voltage divider across the energy source and that the potential along this divider will vary from negative at the bottom of the diagram to positive at the top; further, that the top plates of the .033 and .047 mfd capacitors will be more positive than the bottom plates.

Since these latter are already connected to the HT line, it follows that the potential on the upper plates may achieve a potential more positive than the HT line itself.

EXTRA VOLTAGE

In practice, this positive charge, replenished at the line frequency rate, adds markedly to the voltage which one would normally expect to be available to the horizontal output valve via the series diode. The capacitors are thus charged by the diode and partially discharged by the output valve plate current pulse, each line-scan cycle.

The average value of this boosted voltage, as filtered or measured on a DC voltmeter, often reaches or exceeds twice the nominal HT supply. Thus, with an HT voltage of 275, the "B-plus boost" voltage, as it is termed, may be anything from 500 to 700 volts, depending on circumstances.

It is fairly common practice to operate the vertical and sometimes the horizontal sawtooth oscillators from the B-plus boost circuit in whole or in part, in order to obtain a higher peak output and/or better linearity.

In fact, quite a few 70 and 90-degree receivers have successfully powered their vertical output stages as well from this boosted source, using a triode operating at about 500 volts and 15 milliamps.

But there is more to figure 195 than the mere production of a supplementary voltage.

With the more gradual collapse of the field in both output transformer and yoke, the scanning beam returns, equally slowly, from the left-hand side of the screen to approximate centre. By manipulating the value of all the components concerned, it is possible to arrange that the rate of movement from left to centre is equal to the optimum scanning rate.

By further manipulation and adjustment, it is possible to ensure that, just as the scanning beam approaches centre screen, the horizontal output grid rises above cut-off and a new pulse of plate current carries the beam smoothly across to the right of the screen.

And this was the starting point from which we began to describe the complete cycle of operation.

In fact, it may be helpful to repeat the cycle in brief.

(1) Rising plate current in the horizontal output valve carries the scanning beam from approximate centre screen to the right.

(2) The plate current is suddenly cut-off by the downward excursion of the grid sawtooth drive. The collapsing field, rising subsequently to a peak of reverse polarity, flicks the beam from right to left to provide the return trace.

(3) The diode conducts and causes the new reverse field to subside slowly. This carries the scanning beam at the optimum rate towards centre screen.

(4) A new cycle of plate current through the horizontal output valve maintains the left-right scanning movement as described in (1).

TOTAL SCANNING CYCLE

Thus, in the total scanning action, the damper diode circuit provides the first half of the trace (i.e. left to centre) the horizontal output provides the second half (i.e. centre to right) while an undamped half-cycle of free oscillation, due to the collapsing field provides the retrace.

Figure 196 shows the relationship in graphical form. Note that under dynamic conditions, the transition from the diode or so-called "reaction" scan occurs

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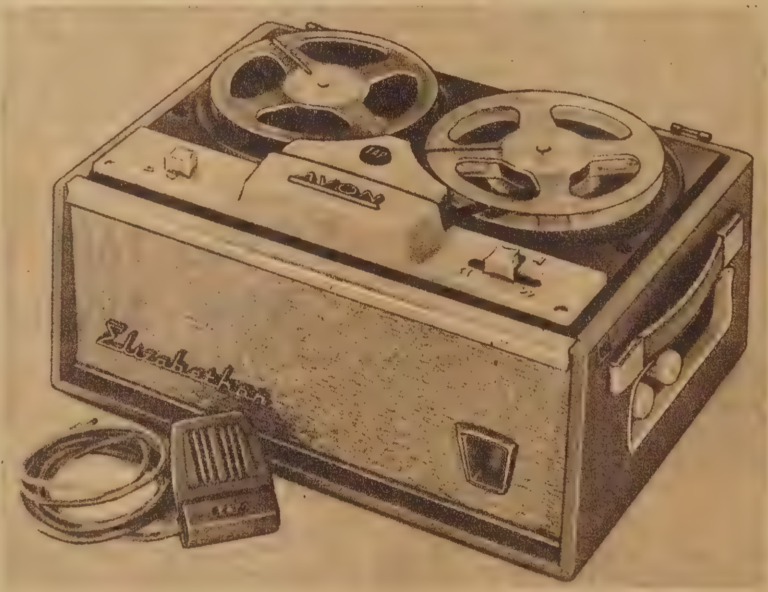

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The scanning action has been described, thus far, in purely general terms and, as might be expected, it cannot be left to chance whether the scanning beam will reach or grossly overlap the extremes of the screen or maintain effective linearity across the screen area.

And quite apart from controlling the functions just described, the designer has to take into account the geometric problems and defocussing effects outlined in the last instalment.

In practice, component designers begin by assuming a certain order of EHT voltage (which governs deflection sensitivity), certain types of horizontal output valve and operating conditions, and proceed therefrom to develop a kit of deflection components which will produce the desired end result.

CORRECT COMPONENTS

Then providing these components are used, together with suitable circuitry, the scan width, linearity and general behaviour of the system will be fairly close to optimum, requiring only minor adjustments. Three such adjustments are provided in the specimen circuit of figure 194.

The grid drive adjustment, already mentioned, governs the bias generated at the output valve grid, varies its "recovery" time from beyond cut-off and markedly affects the current transition region. Excessive drive normally produces a white line down the screen slightly left of centre.

Over and above this the drive has a bearing on picture width, linearity and EHT voltage. In practice, the drive must be adjusted short of the setting which produces the abovementioned white line but not so low as to cause a marked drop in EHT voltage or an undesirable rise in the cathode current of he horizontal output valve.

A second adjustment is provided by the component marked CHL1 "Horizontal Linearity." This takes the form of a small honeycomb wound inductor, whose value can be adjusted by means of an iron-dust core. Typical figures are between 1 and 10 millihenries.

Adjustment of the linearity coil modifies slightly the amplitude and phase of he ripple current and voltage in the B-plus boost storage circuit and, by its influence on instantaneous voltage level, affects particularly the linearity in the ransition or centre region of the screen.

WIDTH CONTROL

A third adjustment is shown as CHW2 Width Coil." Portion of this coil, havng an inductance in the region 3 to 0mH is shunted across a section of the orizontal output transformer. As the nductance is reduced, the transformer loaded adversely and deflection angle reduced.

Simultaneously, inductance is added n series with one lead to the deflecon yoke, again serving to reduce the eflection current.

Reverse adjustment, of course, produces the opposite effect of greater deection angle.

Actually, the series section of the idth coil is rather unusual, and it is ore usual to rely on the simple shunt inding, whose inductance is varied, ther by means of an adjustable core or y selecting different physical tappings n the winding.

These various adjustments are usually highly interdependent in their effects on the horizontal scan, but, in general, the Drive control has more effect on the left-hand side of the picture, the Linearity control affects the centre, while the width control affects the right-hand side.

In regard to other components in the circuit, the 1.5uH choke and 270pF capacitor serve as high frequency filter components. They are intended to prevent the generation of transient signal voltages which could conceivably penetrate RF, IF or video circuits to produce interference modulation in a particular region of each scanning line.

The B-plus boost capacitors usually have a value in the region of .033 to .047mfd and a voltage rating of about 1000.

The two components across the series section of the width coil (2700 and .0022mfd) are meant to suppress damped oscillation in the winding, which can produce faint, whitish bars in the raster, near the left-hand side.

A variety of resistors and capacitors are shown in connection with the leads running away to the deflection yoke, and these vary widely in rating, number and position, from one receiver to another. They serve to provide DC blocking in some cases, damping in others and,

MONTHLY NEWSLETTER

Dear Readers,

This month we would like to briefly mention some of the many items of test equipment which we have available from stock. In choosing our range of test equipment we have tried to cover as wide a field as possible, to enable us to supply any type of equipment for any requirement.

Of particular popularity are the instruments in kit set form, made by Cossor, the principal items being single beam or double beam 4 inch oscilloscope, and an extremely accurate vacuum tube volt meter, the retail prices of which are £76/15/-, £120/8/9 and £29/14/6, respectively. All these kits feature printed circuit boards and are renowned for their ease of assembly. We also recommend the amazing Serviscope which has won wide appeal throughout the service shops of the world, and is fast becoming Australia's No. 1 scope. Also available from our range of equipment are R.C. bridges vacuum tube volt meters, valve testers, grid dip oscillators, transistor testers, crystal calibrators, famous Grundig sweep and marker generators and a full range of Advance or Tailor signal generators and oscillators of all types. We welcome your inspection of any of these lines and will be only too happy to demonstrate these items to you.

Some new miniature speaker systems have also made their appearance on the market recently and are recommended where space is at a premium for medium fidelity stereo. The cabinets of these miniature systems are available in either classical or contemporary styling, and models are available for either floor or wall mounting. The prices of these range from £11 odd for small single speaker systems to £32/10/- for coffee table units, where the enclosure forms a miniature coffee table on legs with 3 speaker system inbuilt with cross-over networks included. The advantages of these speakers would be apparent particularly for the man living in a small apartment or rooms, who still requires good stereo in a minimum space.

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Well, readers, that's about all for this month, but we would like to leave you with the invitation to come and visit us or write to us for any of your electronic needs, and we will do our best to be of service to you.

Yours faithfully,
STAFF

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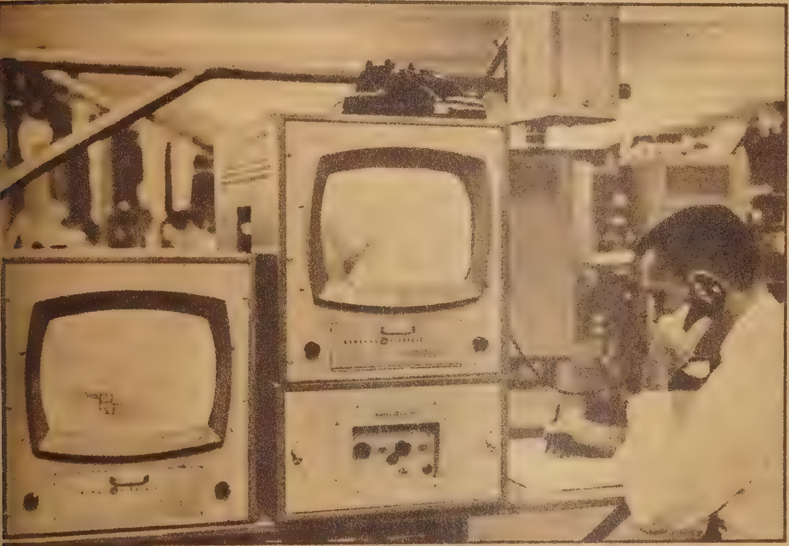
An inter-com. system at each viewing station provides instant two-way communication with the file room for discussion of any tracing. With this system, a section wanting to work with a particular sketch can see it almost immediately. Delay and costs involved in making blueprints and delivering them are eliminated. The system also guarantees that up-to-date blueprints will be in use at all times.

The closed circuit system reduces cost of blueprint reproduction, releasing clerks for more productive efforts.



This picture shows the camera and associated monitors at the blueprint filing section. The camera is at the top of the picture to the right of the monitor screen. The operator's hand and pencil can be seen on the screen, picking out an item on the print.

A COURSE IN TELEVISION

gain, balance between sections of the eflection winding or between vertical nd horizontal windings. Almost invaribly the capacitors are found to have ery high voltage ratings, being usually igh-voltage ceramic types.

Actually there is not much point, just ere, in trying to work out why certain components have been specified, individual circuits, particularly as their hoice in the first instance has often een dictated by trial and error methods.

It is sufficient to work to published ircuit values and, where failure occurs, to effect a replacement with a component of identical value and rating.

A final note concerns the basic conguration of the circuit, as shown in gure 194. Here the damper diode and s associated components are connected cross portion of the transformer priary winding, the cathode being tapped ito a point where it is subject both to e boost voltage and to peak potentials ppearing across the relevant section of the winding.

As an alternative, where the transformer has a separate secondary winding to feed the yoke, the damper diode can be associated with it, instead of with the primary. By suitably phasing the winding, the pulse can be applied to the diode plate, and the the boost voltage taken from the cathode circuit.

The current path from B-plus is through the deflection secondary winding to the diode plate, across the diode to cathode, through the Linearity coil to the bottom end of the transformer primary and thence through portion of the winding to the plate of the horizontal amplifier.

Boost storage capacitors, about 0.47 mfd, bypass each side of the Linearity coil to earth.

Next month, we will continue discussion of the horizontal output circuitry, giving particular attention to generation of the EHT voltage.

(To be Continued).

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Here's your answer, Tom!

As promised last month, we are commencing here the discussion of electronic measuring instruments with special reference to the moving coil meter and its applications. We attempt to show the logical development of this device from the theory of a current-carrying conductor in a magnetic field, and to show its use in the measurement of current, voltage and resistance.

By Jamieson Rowe

AS we mentioned last month, a current carrying conductor in a magnetic field is acted on by a force. As the diagram showed, the direction of the force experienced is at right angles to both the direction of current flow and the direction of the magnetic field.

An easy way of remembering the actual direction of the force is provided by the old "left-hand motor rule." This is usually stated as:

"If the thumb and first two fingers of the left hand are held extended so they are all at right angles, then if the first finger points in the direction of the magnetic field, and the second in the direction of current flow, the thumb will indicate the direction of the force."

CONVENTIONAL CURRENT

Incidentally, the direction of current flow mentioned here is the conventional direction, opposite to the direction of the electron flow. Another point is to remember to use the left hand — otherwise you may wind up with some rather strange answers!

If the field and the current are not initially at right angles, the force is still at right angles to their common plane, but is reduced in size.

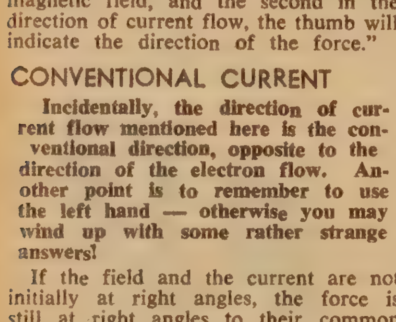
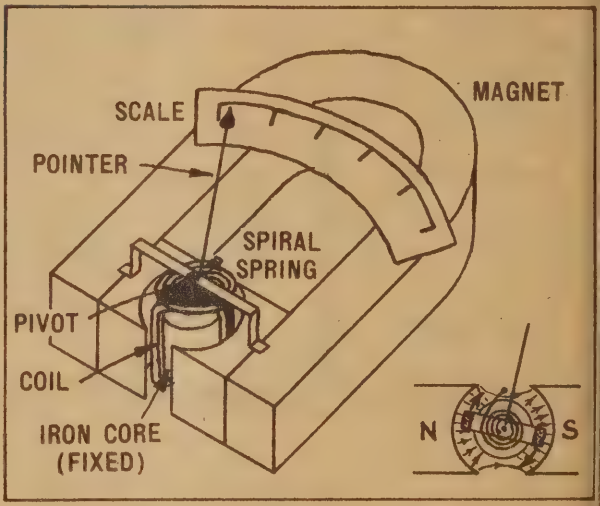


Figure 1. A practical current meter could be constructed along these lines, but it involves problems, as explained in the text.

If the strength of the magnetic field and the length of the conductor are constant, the size of the force is proportional to the size of the current. Thus, if we had a way of measuring a force directly, we could use this as a way of measuring the current. All we would have to do is to find the "force per unit current" of the particular conductor in that particular field, and, thereafter, we can find the current by measuring the force experienced.

Figure 2. Actual moving-coil meters operate on precisely the same principles as the simple unit shown in Figure 1, but incorporate a number of improvements.



This way of measuring current is quite practical, and various devices have appeared which use it. One example is known as "Ampere's current balance." However, it doesn't lend itself to easy readings, so a much easier way was found. This method translates the magnitude of the current into the position of a pointer needle, and is thus quite easily read.

PROPORTIONAL TO POSITION

This is the way it works: the force produced by the current and the field is made to oppose another force which is proportional to the position of a pointer. If one force is larger than the other, the pointer will move, but will finally come to rest at a position where the two forces are equal.

For each different value of the current-produced force, the position of equilibrium will be different, since the other force is proportional to position. Thus we can say that the position of the pointer is proportional to the magnitude of the current and use the device to measure current.

Now a convenient way of obtaining one of these "size proportional to distance" forces is by using an elastic substance such as an elastic band or a metal spring. The more we stretch such things, the more force we have to use. In other words, the size of the deforming force required is directly proportional to the amount of deformation.

Thus by using one of these things as the opposing force in such a current measuring device, we can make a simple "meter." Figure 1 shows a sketch of a device along these lines.

As you can see, the conductor and pointer will move inwards until the produced force is cancelled by that of the stretched spring. The position of rest depends only on the current once the device is calibrated.

This simple device is quite practical but has a number of rather serious disadvantages. One is that, since only one conductor is in the field, large currents are needed to produce useful readings. Thus it is of no use in the measuremen of small currents.

FURTHER DISADVANTAGES

Due to its construction, it must be kept upright, or gravity will upset al the calibrations. Also, the scale will no be linear, since the path of the con ductor is an arc, and does not remain perpendicular to the magnetic field.

The modern moving-coil meter, while retaining the same principle of opera tion as before, is able to solve a grea many of these problems. Figure 2 is a diagram showing the construction o a typical meter.

Instead of a single conductor, there i now a multi-turn rectangular coil, wit jewelled pivots top and bottom. Due t the light construction and quantity of turns, very small currents may be measured. To provide the opposing force (in fact, a torque in this case) tiny spiral springs are attached to both the top and bottom of the coil. The springs also perform another function—they convey current to and from the coil.

By placing a cylinder or "core" of soft iron inside the coil, the field is made radial over the portion travelled by the coil. This means that a scale which is linear, or uniformly calibrated, is produced, as the coil always cuts the field at right-angles.

Meters using this construction have been made with a sensitivity as low as 10 microamperes. In other words, if 10 microamps of current flows through the coil, the pointer is deflected to a full-scale reading.

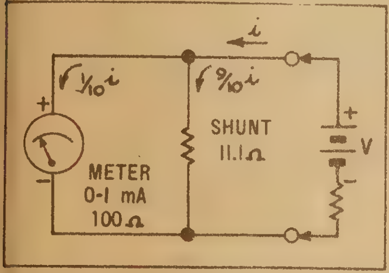


***Figure 3.** This diagram shows how a shunt is used to adapt a moving-coil meter for the measurement of high currents.*

In the realm of high current, moving coil meters may be made to read unmodified by using large coils and thick wire. However, above about 100 milliamperes, it becomes rather difficult to arrange the transfer of current to and from the coil. Thus we find moving-iron meters and moving coil meters with shunts are more common at high currents.

USE OF SHUNTS

Figure 3 shows how a "shunt" resistance is used to allow a moving-coil neter to measure high currents. The hunt is wired directly across the meter terminals, so that any current which lows between the terminals divides be-ween the meter and the shunt.

In the particular case shown, the meter s required to read currents up to ten imes its normal 1 mA full scale reading —in other words, act as a 0-10 mA. neter. Thus the shunt is arranged so hat nine-tenths of any input current asses through the shunt, and only one-enth through the meter.

This is done by making the shunt esistance one-ninth that of the meter. The meter has a resistance, being a coil f wire.) Since it is found that the cur-ent divides in the inverse ratio of the esistances, this produces the desired ffect.

If we wanted the meter to act as a 00 mA. unit, we would have to arrange or 99-hundredths of any current to flow hrough the shunt, and one-hundredth hrough the meter. The shunt value in his case would thus be 1/99 the resis-ance of the meter, or 1.01 ohms.

The moving-coil meter which we have een discussing is obviously only a cur-ent indicating and measuring device. However, it can also be used to indi-ate the magnitude of a PD or voltage. efore we investigate this any further, however, we will have to discuss the relationship between the voltage and current in a circuit.

A glance at Figure 4(a) may make the position clear. When an EMF having a PD of "V" volts is applied to a circuit having a resistance "R," the size of the current which flows is found to be directly proportional to V, and inversely proportional to R. In practice, by suitable choice of units and conditions, current is equal to voltage divided by resistance.

This fact is known as Ohm's Law, in honour of the discoverer, George Simon Ohm.

MEASURING VOLTAGE

Figure 4(b) shows how this law enables a moving-coil meter to be used to measure voltage. If such a meter has a fixed resistance placed in series with it, any current which flows through the combination is directly proportional to the applied voltage or PD. Thus for a particular resistor, the meter scale may be calibrated directly in terms of input voltage.

The size of the fixed series resistor, or "multiplier" as it is called, may be found quite easily using Ohm's Law. For instance, if we have a meter which has a sensitivity of 1 milliamp (1 mA) full-scale, and we wish to use it as a 0-100 volt meter, we use Ohm's Law to discover that a resistance of 100,000 ohms will pass a current of 1 mA if 100 volts is applied.

This value is not that of the multiplier resistance itself, but is the required resistance of the meter-and-multiplier combination. We state it in this way because the meter, being wound with reasonably fine wire, has a resistance itself. The actual size of the required multiplier is thus equal to 100,000 ohms minus the meter resistance.

If the meter has an internal resistance of 100 ohms, which is usually true for a 1 mA. unit, the multiplier will thus have to be 99,900 ohms. The meter may be used to measure full-scale voltages of any desired size (above a certain value, as we shall see in a moment) simply by using the correct multiplier value.

If we try to use this same meter as a voltmeter with a full-scale sensitivity of 100 millivolts (mV.), we find that we need no multiplier, as the total resistance is only 100 ohms, the same as the meter resistance. This is quite in order, but it shows why such a meter cannot be used as a voltmeter with less than 100 mV. sensitivity—unless you put a negative resistance in series with it!

NOT SILLY

(Incidentally, this is not as silly as it sounds, because a negative resistance supplies power rather than dissipates it. Thus we could call an amplifier a negative resistance. It is thus not surprising that an amplifier is the only way to make such a meter read smaller voltages than its basic sensitivity.)

The third main use for the moving-coil meter is in the measurement of resistance. Figure 5 (a) shows the basic circuit for the series ohmmeter circuit, one of the most popular for resistance measurement.

Returning to Ohm's Law for a moment we can see how this circuit works. If the voltage applied to a circuit remains constant, the current which flows has a magnitude which is inversely proportional to the resistance of the circuit. If the circuit is a high resistance one, a small current will flow, and if the circuit is a low resistance one, a large current will flow.

Thus in Fig. 5 (a), if the voltage V remains constant, the meter can be calibrated in terms of the resistance Rx across the terminals. Low resistance will correspond to readings near full-scale, and high resistances to readings at the low end of the scale.

For this circuit, the battery voltage must be equal to the basic voltage sensitivity of the meter, i.e., that voltage which causes full-scale deflection when applied directly to the meter. (Found by multiplying the current sensitivity of the meter by its internal resistance.) This results in the reading for zero resistance at the terminals being exactly full-scale, a very convenient position.

This circuit would be quite practical were it not for one thing: all batteries have an internal resistance. In most cases the internal resistance is not even constant, but slowly increases over the life of the battery, which is even more awkward.

PRACTICAL SOLUTION

Thus what is commonly done is shown in Figure 5 (b). The battery used has a higher voltage than the basic voltage sensitivity of the meter. This enables a varable resistor to be placed in series with the circuit, to compensate for the variation in battery resistance.

To adjust the circuit before use, the input terminals are shorted together, and the resistor adjusted for full-scale deflection, i.e., at the zero ohms calibration. The unknown resistor is then placed across the terminals, and its resistance can be read directly.

As the current readings of this circuit are inversely proportional to the resistance present, we find that the resistance scale on the meter dial is non-linear, and cramped at the high-resistance end. (This is because the graph of an inverse function is exponential.)

(Continued on Page 67)

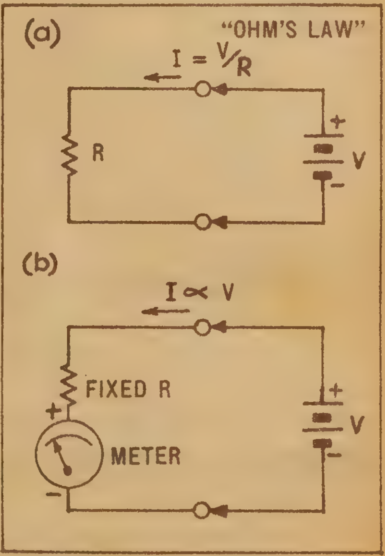


***Figure 4.** Using the circuit relationships given in Ohm's Law, a multiplier resistor can be used to convert the meter into a voltmeter.*

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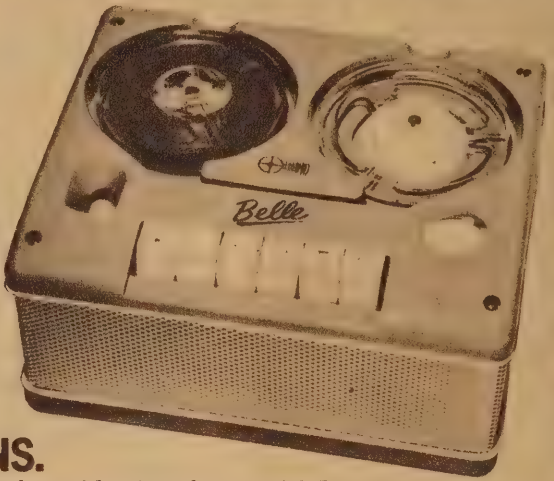

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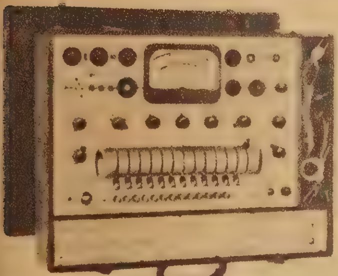

Model 10-60: Etched, satin-brushed aluminum panel. Sturdy carrying case with tool and accessory compartment and hinged removable cover. Dimensions: 20 x 15 x 7".

Complete with detailed technical manual.

PICTURE TUBE TESTING ACCESSORIES AVAILABLE
(See page 6 for descriptive details)

Model PTA Pix Tube Adapter	£7/5/0
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Model 10-60 *Electronamic* TUBE TESTER

includes TRANSISTOR AND CRYSTAL DIODE TESTER, VOLTAGE REGULATOR AND PICTURE TUBE TESTER

***The all-inclusive, positive, vacuum tube performance test that is not limited to Mutual Conductance alone.** *(See technical details on pages 2 and 3)*

The Model 10-60 is an advanced, industrial type instrument specifically engineered to meet the needs of modern electronic production and maintenance testing. Ideal for the well equipped industrial laboratory, service shop and technical school.

At a remarkably modest price, the 10-60 provides an unparalleled combination of functions:

1. Comprehensive Tube, Transistor, Crystal Diode and Picture Tube Testing.
2. Ultra-Sensitive Gas Test, read directly on meter.
3. Functional Testing of Voltage Regulator Tubes.

AUST. PRICE
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PLUS S.T.

TUBE TESTING FEATURES

- **POSITIVE, all-inclusive tube performance testing** . . . not limited to mutual conductance alone. Effectively tests tubes over a complete path of operation . . . not at just one arbitrary point.
- **Tests all modern tube types** . . . including sub-miniatures.
- **Filament voltages** from .75 up to 117 volts.
- **Absolutely Free-Point Lever Element Selector System:** affords the utmost protection against obsolescence. Locates and isolates every tube element regardless of base positions or frequency of termination.
- **Dual short-check sensitivity.** Special low voltage short-check circuit guards against damage to tubes under test.
- **Built-in stainless steel pin-straighteners:** 7 and 9 pin types.
- **Functionally tests voltage regulator tubes** for voltage regulation at manufacturer's specified current limits.
- **5-window, geared roll chart** provides convenient reference for all tube and transistor test settings.
- **Ultra-sensitive gas test circuit** directly detects troublesome gas content on sensitive PACE 50 microampere, 5½" meter.

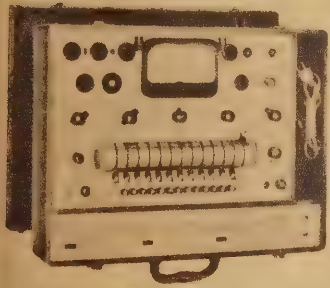
TV PICTURE TUBE TESTING

- **TV Picture tubes tested in specially engineered circuit** – for picture producing beam current (requires optional accessory PTA picture tube cable adapter and PAA 110° socket adapter).

TRANSISTOR AND CRYSTAL DIODE TESTING FEATURES

- **Designed in accordance with recommendations of leading semi-conductor manufacturers.**
- **Widespread I_{CBO} ranges cover** all types of transistors – low, medium and high power – n-p-n and p-n-p types.
- **Wide range of collector potentials:** .5 volts DC to 160 volts DC in 22 steps.
- **Direct-reading beta ranges:** Employs separate injection currents for low and high power types.
- **Leakage:** Reliable check of emitter to collector leakage current provides basis for accurate gain tests.
- **Crystal diode tests:** 22 selected DC voltages for forward and reverse current tests in accordance with manufacturer's specifications.
- **Lever selector plus a Universal Semi-Conductor Adapter** provide for accommodation of all present and future semi-conductor releases.

- **Free Tube and Transistor Test Data Subscription Service** to all registered owners, for one full year!



Model 10-40: Etched, satin-brushed aluminum panel. Sturdy carrying case with tool and accessory compartment and hinged, removable cover. Dimensions: 20 x 15 x 7".

Complete with detailed technical manual.

Model 10-40 *Electronamic* TUBE TESTER

includes VOLTAGE REGULATOR AND PICTURE TUBE TESTER

The Model 10-40 is physically and electrically similar to the comprehensive Model 10-60 described above, but does not incorporate the specialized additional circuitry for testing transistors and crystal diodes.

The Model 10-40 is specifically engineered for applications where the user prefers to maintain separate facilities for vacuum tube and semi-conductor testing. (See details of Model 960 Transistor and Crystal Diode Tester, illustrated and described below.)

The Model 10-40 employs the same picture tube testing accessories as listed for use with the Model 10-60.

Free Tube Test Data Subscription Service to all registered owners, for one full year!

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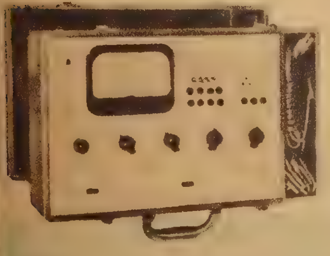

Model 960: In portable, well-constructed covered carrying case with accessory compartment and hinged, removable cover. Etched, satin-finished, 3 color aluminum panel. Case Dimensions: 18" x 10½" x 6¼".

Complete with detailed technical manual.

Model 960 TRANSISTOR and Crystal Diode TESTER

The Model 960 is a comprehensive, up-to-the-minute, semi-conductor test set designed for practical, reliable testing of transistors and crystal diodes. It is equally "at home" in the laboratory, field or shop.

The 960 is completely powered from a built-in AC actuated power supply and does not require any batteries.

The specialized circuitry and operating parameters have been engineered in cooperation with leading semi-conductor manufacturers.

AUST. PRICE £67/10/0
PLUS S.T.

PERFORMANCE FEATURES

- **Direct I_{CBO} Readings** in terms of true collector current.
- **Five I_{CBO} Ranges** cover all types of transistors – low, medium and high power . . . n-p-n and p-n-p types.
- **Wide Range of Collector Potentials:** .5 volts DC to 100 volts DC in 17 steps.
- **Direct-Reading Gain Ranges:** Employs five separate injection currents for low, medium and high power types.
- **Leakage:** Reliable check of emitter to collector leakage current provides basis for accurate gain tests.
- **Crystal Diode Tests:** 17 selected DC voltages for reverse current tests. Also provides separate forward tests.
- **Wide-Angle, 5½", 100 microampere sensitivity PACE meter.**
- **Transistor Test Settings** listed on high speed roller chart.
- **Patchcord Element Selector System** and universal semi-conductor adapter provide for accommodation of future semiconductor releases.

- **Free Transistor Test Data Subscription Service** to all registered owners, for one full year!

READ ALL ABOUT "ELECTRONAMIC" VALVE TESTING — SEE OVER.

THE
PRECISION
*Electronamic**
TUBE TESTING
CIRCUIT

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PRINCIPLES OF *Electronamic* TUBE TESTING

The All-Inclusive, Positive VACUUM TUBE PERFORMANCE TEST that is Not Limited to Mutual Conductance Alone

The *PRECISION Electronamic* Circuit is employed in *PRECISION* Models 10-60 and 10-40 described and illustrated on page 1.

★A most perplexing issue which confronts the electronics engineer and service technician is the choice of tube testing equipment that will solve tube test problems with **greatest possible accuracy and reliability.** With this thought foremost in mind, ***PRECISION*** engineers have devoted much time in extensive vacuum tube testing research and development.

All varieties of tests were conducted upon thousands of tubes, at our own fully equipped laboratories and at the plants of leading tube manufacturers. From this, a vital point stood out, above all others, which dictated that **"the resultant tube tester design cannot be based upon just one selected characteristic, such as just mutual conductance alone."**

★ A tube test based upon **just any one characteristic** does not fully vouchsafe the overall performance capabilities of an amplifying tube.

When a vacuum tube is "receiver tested", the electronic circuits demand **performance** predicted upon the simultaneous presence and interaction of a multiplicity of tube characteristics including the following:

Electron Emission
Amplification Factor
Plate Resistance
Mutual Conductance (Transconductance)
Plate Current
Power Output, etc.

★ To perform a whole series of such individual tests, in order to evaluate the overall merit of a tube, involves a collection of laboratory equipment hardly available to the general user of vacuum tubes. In addition, these characteristics are very closely knit to operating parameters. This means that these variable characteristic values are dependent upon the voltage, current and load conditions to which the tube, under consideration, may be subjected. This further means that for any given tube type, **there is not just one value of mutual conductance or power output, etc., characteristic of that tube.**

For this very reason, tube characteristic manuals list curves (graphs) of operation to assist the design engineer in selecting tubes and circuit parameters which he **desires** to employ in the particular receiver or other electronic apparatus being developed.

The data listed in tube manufacturers' manuals are not fixed and inflexible ratings. Rather, such examples of operating conditions are given merely as guiding information. The tubes can be and are used under **any** suitable conditions within their maximum ratings. The **curves** provide the information to determine the proper operating points which will yield a required characteristic.

★ Another aspect of the tube engineering problem is the question of rejection limits for any particular characteristic. This actually is a double-barrelled topic. New tube production is concerned with **"Production Tolerance Limits."** The electronic design engineer, and of course the apparatus which uses the tubes, are further interested in **"Life Test End Limits."**

Electronic apparatus, using vacuum tubes, must not only perform well with tubes which are within **"Production Tolerance Limits,"** but should be able to perform until the tube has reached its **"Life Test End Limit."**

Detailed specifications of such "limits" are not generally available to the field and of course, specific **numerical** characteristics tests (such as micromhos) are inconclusive unless compared to a detailed table of limits paralleling actual test parameters or actual operating conditions.

Moreover, numerical characteristics readings (such as micromhos) are not fully meaningful unless the tester **duplicates** the exact voltages and loads under which the particular tube in question is actually operating **in the specific circuit from which it has been removed.** It would furthermore require reference to the tube's plate family and transfer characteristic curves in order to determine what the numerical characteristic should be under the particular conditions in which the receiver is using this tube.

★ Therefore, since the numerical value such as micromhos) of a tube characteristic varies so widely with the applied element potentials, it is necessary that TRUE vacuum tube characteristics **measuring** instruments provide:

1. Means for **metering** and reading each and every applied element potential.
2. Appropriate means for **metering** and reading each tube element current.
3. Suitable devices for **adjustment** and **control** of every element potential to duplicate operating conditions or to set up the specific operating point being investigated.

★ It is obviously impractical to construct such a device, for general tube testing, as would permit the operator to do this; not only from the viewpoint of simplicity of operation, but also in consideration of the extremely high cost and physical size.

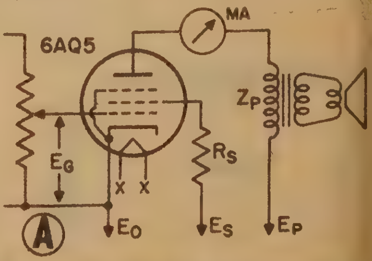
Accordingly, such equipment (for actual **numerical** characteristics investigation) is usually only found in research and production laboratories. These are the only places wherein such elaborate equipment might ever be required.

Needless to say, it would also not be practical for a tube tester's chart data to offer a multiplicity of alternative test settings for each and every tube.

★ It has therefore been the constant purpose of ***PRECISION*** engineers to develop a tube tester circuit which would best meet the **realistic** needs of the industrial electronics and service-maintenance professions; to develop a basic test circuit affording the ultimate in correlation between test results and actual "in application" performance.

In the course of such investigations, it becomes conclusively apparent, that regardless of amplifier tube type number or variety of circuit applications, one phenomenon constantly manifests itself: **the tube output (voltage or power) is the result of a plate current caused by an applied control grid voltage, *which current must be adequate up to and including full peak operating conditions.*** This being a basic concept of amplifier tube operation (involving all operating characteristics), it led to the now famous time-proven and tried, ***PRECISION Electronamic*** tube tester. (Reg'd U. S. Patent Office)

★ In offering the *Electronamic* tube tester, to the discriminating purchaser, ***PRECISION*** does so with a **"performance checked"** background. Such "performance" tests, heavily emphasized during World War II, were based upon the primary purpose of the instrument – TO FIND BAD TUBES!



PRECISION **TEST EQUIPMENT IS VERY ECONOMICAL –** ASK YOUR DEALER ABOUT THE STEANE PRECISION PAY-AS-YOU-USE PLAN

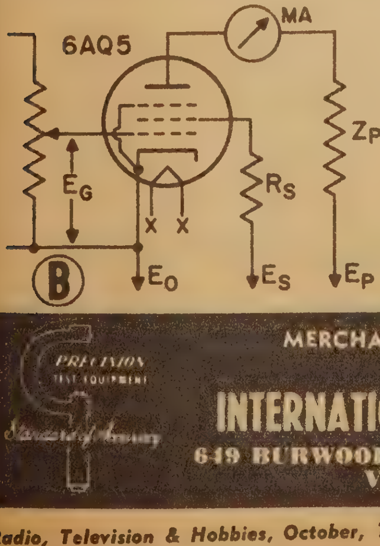
★ To familiarize ourselves with the principles of the ***PRECISION Electronamic*** circuit, let us briefly observe the operation of a simple modern pentode such as the 6AQ5, in a standard power amplifier stage, shown in Diagram A, with the addition of a current indicating meter in the plate circuit.

The primary purpose of this tube is to deliver electrical output to the speaker through plate load Zp, in the following manner: with filament and plate supply operating and with zero signal applied to the input circuit, the plate milliammeter "MA" will indicate a steady current flow dependent upon tube geometry, cathode emissive power and the potentials of the interspaced elements. This zero signal meter reading is an indication of the tube's plate conductance. By applying an audio signal, Eg, to the input grid, THE PLATE CURRENT THROUGH Zp MUST VARY IN ACCORD WITH THE CHANGES IN GRID VOLTAGE. This is dependent upon the mutual conductance, plate resistance, amplification factor, load resistance, etc. The greater the grid voltage swing, the greater should be the plate current excursions, and accordingly, the louder the sound from the speaker.

Let us now assume that a high order of peak grid signal voltage is applied (that is in keeping with the tube operating conditions), but severe distortion is nevertheless produced at the speaker, even though all circuit components, aside from the tube, are normal. This condition coincides with low peak plate current readings, and is usually caused by poor cathode structure and/or high plate resistance. In other words, an insufficient quantity of electrons is available to the plate circuit to handle peak power requirements.

Now let us suppose that with a normal signal applied to the input circuit, insufficient or no volume is obtained from the speaker, again assuming all circuit components, aside from the tube, are normal. This condition would indicate that the magnitude of plate current variations versus applied grid signal are not in keeping with the tube specifications and circuit requirements. This can be caused by a multiplicity of internal tube conditions, including reduced amplification factor, low mutual conductance, open, misplaced or shorted screen, control grid, suppressor, or plate, even though the tube's cathode structure may be absolutely normal.

In the case of resistance-coupled amplifiers, the change in plate current produces a change in voltage drop across the plate load resistor. This is then passed on through suitable coupling means to the succeeding stage.



★ It can therefore again be readily seen that the overall PERFORMANCE Merit of a tube is absolutely dependent on the ability of output plate current to respond to the applied grid voltage, *over the full range of possible operating conditions* ... which involves More than just Mutual Conductance.

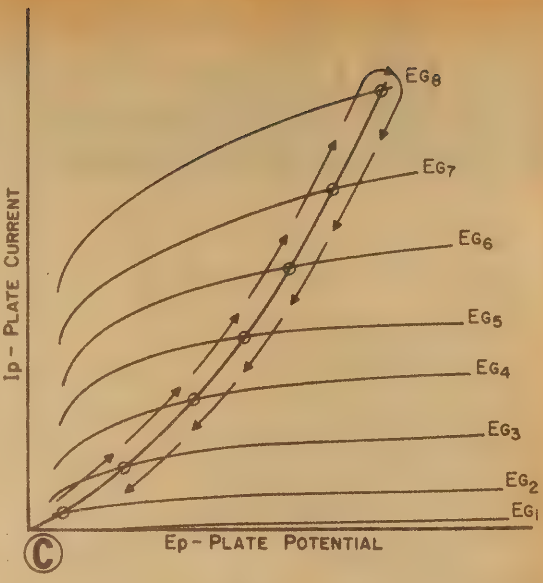
Diagram B shows a simplified breakdown of how the ***PRECISION Electronamic*** circuit is set up to check the same type 6AQ5. Note that individual plate, screen and grid voltages and loads are applied to the respective elements of the tube under test and it thereby being *Electronamically* tested as a pentode. Plate supply voltages from 12 to as high as 300 volts are applied to the tubes under test depending upon the individual tube's requirements.

Appropriate treatment is accorded all amplifier tubes depending on whether they are triodes, tetrodes, etc. Multi-purpose tubes are treated and tested as two or more completely independent tubes, WITHOUT REMOVING THE TUBE FROM THE TEST SOCKET. All plate, screen, grid and filament test voltages and respective loads are factory calibrated (per the roller chart) to assure the high tube performance correlation for which the *Electronamic* tube testers are known to the field, both civilian and the military – a performance check based upon the peak service for which the tube was designed rather than just an arbitrarily chosen low or midpoint.

★ As previously outlined, the overall quality or performance merit of a tube is dependent on how well control grid voltage "controls" plate current over a complete range of tube application.

For this reason, the ***PRECISION Electronamic*** circuit places the TUBE MERIT METER in the plate or output section of the tubes under test. Accordingly, the resultant quality or performance figure of merit involves a whole series of meaningful operational factors, not just one inconclusive characteristic. Such demanding test will reject all tubes which do not come up to the same standards from which the tube chart data is prepared.

★ Much of the success of the *Electronamic* tube tester is attributable to the ELECTRO-DYNAMIC SWEEP nature of its circuit operation. Through application of appropriately phased individual element potentials, the tube under test is dynamically swept over a Path of Operation, on a sinusoidal time base, encompassing a wide range of plate family characteristics curves. In brief, the tube under test is made to perform on a basis which involves its ability to operate at a multiplicity of potential peak conditions rather than at just one arbitrarily chosen point.



Reference to Diagram C graphically and directly illustrates this *Electronamic* picture. It is this encompassing Path of Operation, involving More than just Mutual Conductance, which is automatically integrated by the meter as the resultant figure of merit in the direct and non-confusing terms of REPLACE-WEAK-GOOD.

★ The very nature of the *Electronamic* circuit necessitates and assures utmost instrument flexibility, to permit positive location and selection of all tube elements. This is accomplished in the "10-00" Model Tube Testers via design and use of a free-point, lever type master element selector system in combination with a multiple push-button, short-check unit . . . PLUS specially engineered rotary, load and element potential selectors.

★ Aside from the development of the complete *Electronamic* circuit, special consideration was given to the design of a reliable direct reading Gas Test, Hot Cathode Leakage Test, inter-element Short Check, and instantaneous Filament Continuity Test, to show up electrical and mechanical tube defects such as cathode to filament leakage, shorted, loose or open elements, open filaments, etc.

The cathode leakage circuit sensitivity and test voltage is adjusted to comply with the approved leakage specifications of leading tube manufacturers. Inter-element short-check voltages have been critically selected to provide most effective test results without electrostatic damage to sensitive tube elements. Additional independent circuit facilities appropriately accommodate diodes, rectifiers, tuning eyes, gas rectifiers, thyratrons, voltage regulators, etc.

★ Modern methods of instrument construction, telephone cabled wiring and highest quality of materials afford maximum ruggedness for long-lasting satisfaction. Every instrument is individually calibrated against laboratory standards, to assure maximum accuracy, and controlled, uniform ***PRECISION*** performance.

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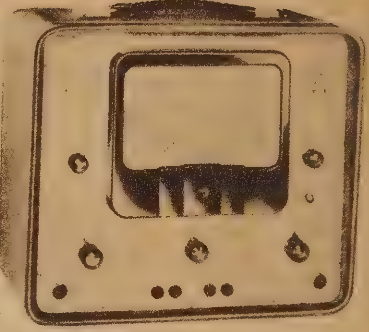


The Model 98 is ***PRECISION's*** finest vacuum tube voltmeter. Its long-view 7" meter, 55 ranges, 9 functions and extra-high sensitivity provide the ultimate in performance, versatility and ease of application.

Electrically similar to the compact Model 88, listed above, the Model 98 also provides the additional functions of 8 DC current ranges and 6 Decibel-Output Meter ranges.

AUST. PRICE £85-5-0 Plus S.T.

ADDITIONAL FEATURES AND SPECIFICATIONS:

- **8 DC Current Ranges:** 0–300 microamperes 0–1.2–6–30–120–600 MA 0–1.2–12 amps.
- **6 Decibel-Output Meter Ranges:** −20 to +63 DB. 0 DB = 1mw, 600 ohms.
- **Extra Large, Easy To Read, 7" PACE Meter** 200 microamperes sensitivity, ± 2% accuracy

Model 98-MCP: (Illustrated) in custom-styled, hooded cabinet and two-color satin-brushed aluminum panel. Dimensions: 11½" x 13" x 6⅝". Complete with 3-way VTVM probe and manual. **Code: Print**

Model 98-P: Same instrument as 98 MCP except in portable hardwood cabinet with hinged removable cover. 12" x 13" x 6".

ACCESSORIES AVAILABLE
FOR USE WITH MODEL 88 AND 98 VTVM'S

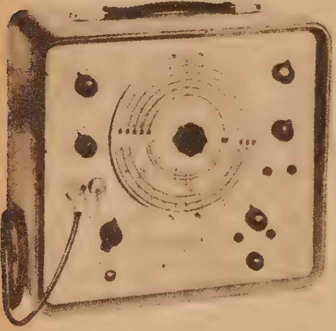
Model TV-8: Super high voltage safety test probe, complete with x 100 multiplier cartridge for ranges to 60 kv. DC. **Code: Extra**

Model RF-10A: High Frequency Vacuum Tube Probe **Code: Probe**

Model LC-1: Custom designed carrying case for use with the Model 88. **Code: Curry**

PART NO. ST-1: Retractable snap-on stand, permits convenient 45 degree table mount of Model 88.

Model E-200C The Modern, Multi-Band SIGNAL-MARKING GENERATOR



The famous, general-purpose RF signal generator whose exceptional stability and accuracy have made it the number one choice of radio-TV service technicians and technical schools everywhere. Model E-200-C is also an excellent variable-frequency marker generator for use with the Model E-400 or similar high-quality sweep signal generator.

- **Frequency Coverage:** 88 kc to 440 Mc (110 Mc on fundamental). 6½" brushed aluminum dial is direct reading in 10 bands up to 440 Mc. 1% accuracy on all bands.
- **0-1000 Point Vernier Scale,** direct reading to one part in 1000, for hand calibration and frequency spotting.
- **The Circuit** — 6AU6 in stable E.C.O. circuit, 6U8 sine-wave audio oscillator-modulator, 5Y3 full wave rectifier.
- **400 Cycle Sine Wave Audio Oscillator** — over 75 volts output, fully adjustable at front panel.
- **Dual Shielded RF Attenuators**—provides for smooth stepless control of RF signal.
- **Shielding** — Compartment shielding of vital components — Power transformer electrostatically shielded. AC line is RF filtered.
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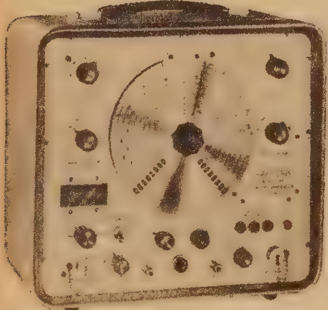
- **Four Types of Signals**—"Unmod. RF", "400 Cy. Mod. RF", "Externally Mod. RF", "400 Cycle Audio Output."
- **Direct Reading Variable Modulation Control** — 0-100% — triples signal utility as against obsolete fixed or stepped modulation of only 30 or 40%.
- **Built-In AVC-AGC Bias Substitution** — Overcomes alignment troubles arising from varying receiver AVC and AGC.
- **Hand Calibrated** — Each instrument is individually calibrated on each band, against laboratory crystal standards.

Model E-200-C (illustrated): in custom-styled, blue-grey, hooded, steel cabinet; two-color satin-brushed aluminum panel. Case dimensions 11½ x 13 x 6⅝ inches. Complete with technical manual "Servicing by Signal Substitution."

AUST. PRICE £68/8/0 PLUS S.T.

Model E-400 SWEEP SIGNAL GENERATOR



Application-engineered specifically for modern FM and TV oscillographic alignment procedures, the E-400 is characterized by the utmost flexibility and stability. It affords an unparalleled standard of performance and value for the efficient TV-FM service laboratory and test bench.

- **Direct Frequency Reading** — 3 to 900 Mc in 8 bands. Harmonically calibrated from 390 to 900 Mc. All VHF Channels (2 thru 13) are directly calibrated on the tuning dial.
- **6½" Etched Aluminum Tuning Dial** — engine-turned finish.
- **1500 Point Vernier Scale** for close calibration and convenient setting of special frequencies.
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- **Voltage Regulated Oscillators** are free of normal power supply and line voltage variations.
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- **Selected, True High Frequency Circuit Components** ceramic and air dielectric capacitors; rugged National SLF tuning condenser; modern miniature HF tubes; mica-filled low-loss sockets; compensated reactance modulator, etc.
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Model E-400 (illustrated): In custom-styled blue-grey, hooded, steel cabinet; two-color satin-brushed aluminum panel. Case dimensions 11½ x 13 x 6⅝". Complete with 2 crystals and comprehensive instruction manual.

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- **6 AC Voltage Ranges:** 5000 OHMS PER VOLT 0–1.5–6–30–150–600–3000 volts.
- **5 DC Current Ranges:** 0–60–600 μA 0–6–60–600 MA
- **3 Resistance Ranges:** Self-contained batteries. 0–2000–200,000 ohms 0–20 megohms.
- **6 Decibel Ranges:** −20 to +71 DB; 0 DB = 1 Mw, 600Ω.
- **Wide-Vision, 3½ Inch, Rugged PACE Meter** 50 microamperes sensitivity, ± 2% accuracy.
- **1% Multipliers and Shunts.**
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Model 110: Complete with ohmmeter batteries, test leads and instruction manual. Dimensions: 1 11/16 x 3½ x 5⅜".

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• ANSWER TOM

(Continued from Page 61)

Because of this, the measurement of high resistance values is rather hard with this simple circuit. To solve this difficulty, many meters have another resistance measuring range, in which a battery with a higher voltage is used, and a large series resistor is placed in the circuit.

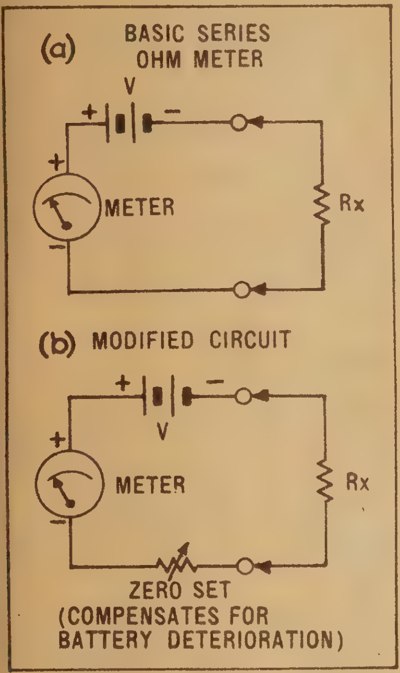

***Figure 5.** For the measurement of resistance, we again take advantage of the circuit relationships given in Ohm's Law. The series ohmmeter is shown here.*

The zero-ohms and infinite-ohms readings are still the same, but the exponential is, in effect, expanded, and the high resistance readings less cramped.

While we are still dealing with the simple series ohmmeter circuit, note that the correction of the zero-ohms point (to compensate for battery deterioration) with the series resistor introduces inaccuracy. This is because the shift to another voltage alters the absolute values of the scale readings.

The only way to compensate for reduced battery voltage and still retain the accuracy is to increase the sensitivity of the meter. This can be done by having a variable shunt across the meter, and gradually increasing its value as the battery voltage drops. In this way the absolute value of the readings is not altered.

(Incidentally, this is assuming that battery voltage really drops with deterioration, whereas part at least is due to a gradual increase in internal resistance—so the simple series circuit isn't too bad after all.)

The series ohmmeter is also at a disadvantage in practice when the measurement of low resistance is attempted, for purely practical reasons. One is that for a low ohms range, a battery voltage substantially less than 1.5 volts is usually required, which is impractical. In addition, the meter internal resistance becomes larger than the required series resistor, making full-scale deflection impossible.

Because of this, various other circuits have been developed for the measurement of low resistance. One is the shunt ohmmeter, which uses the resistance to be measured as a meter shunt. The scale on this type of meter runs in the opposite direction to a series type, with the low resistance values near the low current end of the scale.

The resistance scale on this type of meter is also non-linear (although not a simple exponential), but is cramped at the high resistance end, which does not usually matter.

Another type of ohmmeter used for low resistances is really another version of the normal series type. In this circuit a shunt is placed across both the meter and the variable series resistor. This both decreases the meter sensitivity (in effect) and reduces the series resistance, allowing lower resistances to be read accurately and easily.

Figure 6 shows the basic circuits of the shunt and modified series ohmmeter circuits used in the measurement of low resistance.

The three uses for meters which we have discussed are the basis for all the applications of the moving-coil meter in electronics. In instruments such as the familiar "multi-meter," they are all performed by one meter movement in a flexible circuit, while in other devices only one function is performed.

NEXT MONTH

Next month we will discuss the Vacuum Tube Voltmeter, which has a number of advantages over the normal "moving-coil with multiplier" type of voltmeter. Using a moving-coil meter in conjunction with thermionic valves, it is considerably more sensitive, and loads the test circuit far less than the simpler type which we have been discussing.

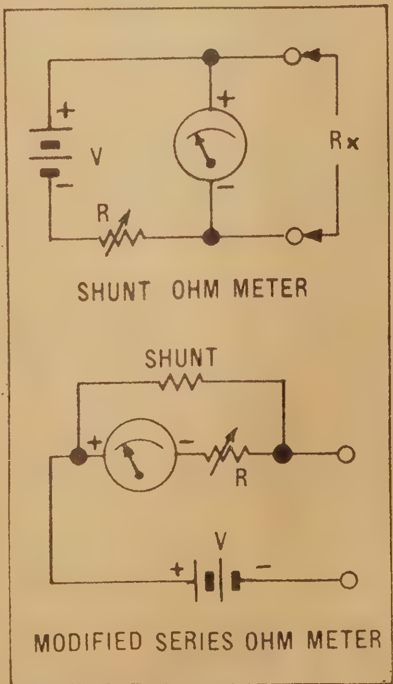

***Figure 6.** This diagram shows the shunt and modified series ohmmeters, both used to measure low values of resistance.*

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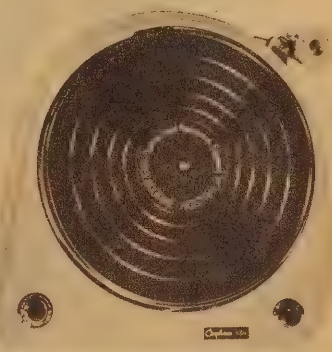

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The C.S.I.R.O. has been responsible for a good deal of valuable pioneering work in regard to solar heating in Australia, and much of their data was used by the author in constructing the unit on which these articles are based. Here is an experimental set-up at the Melbourne C.S.I.R.O.

The Solar Heater—How It Operates

Interested in obtaining your domestic hot water for nothing? Sounds fantastic, doesn't it? But it's true, and there are no catches. This is the first of two articles written by a typical handyman who has built and installed a most successful solar heater in his Sydney suburban home. It explains the theory and operation of the system, and the second one will tell you how to build it.

By Reg. Johnson

THERE is no doubt that a copious supply of hot water, "on tap," is one of the luxuries of modern living. Most of us take it for granted these days, since the majority of modern homes employ a hot water system of some kind, at least where gas or electricity is readily available.

And what a far cry it is from those days, not so long ago, when Saturday night was bath night, and preparing a bath was an afternoon's work. There was wood to be chopped, a cranky copper to be stoked, and, as like as not, the hot water to be manhandled a bucketful at a time from the copper to the bathroom.

Small wonder that the bathroom itself was often an afterthought, "tacked" on to the main building wherever it could be fitted.

The bath heater was a step forward, but whether it used chips or kilowatts, it was seldom convenient to set it in operation for those small quantities of hot water needed so frequently in the kitchen, bathroom, or laundry. The hot water tap was still a housewife's dream.

And it is only in the last decade or so that this dream has come true. Mass production has brought down installation costs and a growing population has effectively lowered the cost of fuels — one of the major barriers in the past. As a result the hot water system has ceased to be a luxury and is now regarded as a necessity — a fact which, however, doesn't make the hot water any less enjoyable!

But the heat we use still has to be paid for. To be sure, most of us pay up with a smile and reckon it's worth the cost, but that doesn't mean we wouldn't welcome the same service for nothing if we could have it.

EXPENSIVE

For the truth is, heating water is an expensive business. The specific heat of water is higher than that of any other common liquid or solid. Only in the gases do we find two, namely helium and hydrogen, which can be grouped above it. The specific heat of a substance is considered to be the number of calories required to raise one gram of it by one degree C.

Water will absorb more heat than an equal weight of any other common substance for the same temperature change. To quote one learned American, "Its heat storing capacity is analogous to the water storing capacity of a sponge."

The quantity of heat, one calorie, which raises the temperature of one gram of water by 1 degree Centigrade, will raise the temperature of one gram of iron by 9 degrees Centigrade.

Proof of this statement can be readily seen if one applies identical heat to equal masses of these two substances. The temperature of the iron will literally soar to 212 degrees F., whereas the water in the same time would only be warm. This also works the same way when cooling. Starting both down the scale from 212 degrees F. the iron will cool to room temperature quickly, while the water remains quite hot.

It is this tenacious resistance to heat change that makes water heating a relatively costly business. With the use of modern heating methods the temperature can be built up quickly and, with the aid of superior insulating materials, the heat can be stored for long periods, but there remains the cost of the operation to be considered.

Yet there is a method of water heating, solar absorption, which costs absolutely nothing to run. And, on a warm summer day, it will not only raise the storage tank temperature in a few hours, but will continue to replace the hot water as it is used throughout the day.

A good example of the performance can be shown by reference to the output of the unit described here.

The occasion; the family washday. Tank temperature 155 degrees F. amount used, 20 gallons. Time taken to "do the wash" and other associated chores, one hour. Tank temperature at that time 150 degrees F. rising to 165 degrees later in the day, all by solar absorption.

Over the years considerable effort has been made to use the sun as a source of energy. No one particular success has been quite so positive as that which has been achieved in the heating of water. Experiments, particularly since the war, have shown that a considerable saving can be made by following certain methods of solar absorption. Readers have no doubt heard about these experiments, but lack of "know-how" probably has discouraged most from attempting the construction of such a unit.

PRACTICAL MODEL

Here, however, is an example of a heater which is at this very moment making great inroads into the heavy cost of water heating. It was built completely by one who did not possess any special knowledge of tradesmanship which could be classed above that of the average handyman. The output of this unit will unquestionably heat a 60-gallon tank faster than a 2.5 kv hot water tank element. (Given good weather.)

For those who do not wish to embark upon the project because of the time factor, at least one manufacturer can supply a similar unit in the "kit of parts" manner or will even make, supply and erect the entire unit for you.

Let there be no mistake about solar hot water systems. They work—and work with surprising efficiency. Already installed in many homes, factories, hotels etc., they are making a worth-while contribution to economical water heating. In fact, they enable us to use one of the few things remaining in this world which may be regarded as "free."

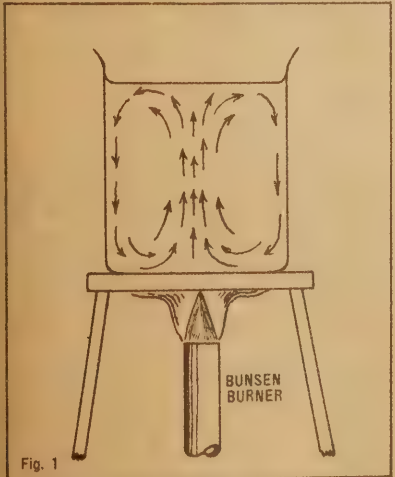

Fig. 1

A simple example of convection. The heated liquid expands, decreases in weight per unit volume, and rises to the surface. Cold liquid replaces it, is heated, and the process repeated.

TYPICAL CONVECTION CURRENTS

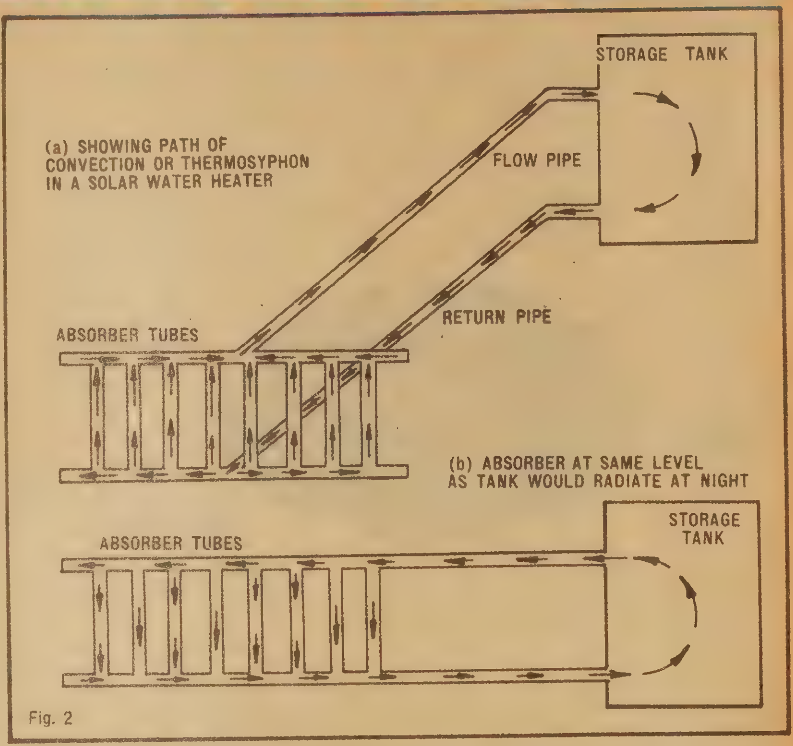
STORAGE TANK
(a) SHOWING PATH OF CONVECTION OR THERMOSYPHON IN A SOLAR WATER HEATER
FLOW PIPE
RETURN PIPE
ABSORBER TUBES
(b) ABSORBER AT SAME LEVEL AS TANK WOULD RADIATE AT NIGHT
STORAGE TANK
ABSORBER TUBES

Fig. 2

Two methods of connecting a solar absorber to a storage tank. At (a) the rise from the absorber to the tank prevents "reverse convection", but at (b) this can happen and the heat stored during the day will be wasted at night.

Generally there are two ways to heat with sunlight, one by focus, the other by absorption. The latter method is the most recommended. Focusing apparatus, being quite costly and in need of constant adjustment, cannot be compared with the simplicity and robustness of the flat absorber. Once constructed, the unit will give a lifetime of faithful service, maintenance being confined to a coat of paint to the exterior every three to five years. Some 50,000 such units are at present in operation in the State of Florida, U.S.A.

DULL DAY OPERATION

One question frequently asked concerning solar absorption is: What happens if it rains or becomes overcast? Naturally, the unit cannot operate as well under these conditions, but the rays of the sun penetrate all but the very heaviest of clouds to some extent, and will raise the water temperature in proportion.

Summer temperature of cold water averages around 75 degrees, and in winter about 52 degrees. With solar contribution on cloudy winter days the temperature will rise to 90 or 100 degrees. In summer, cloudy day performance is even better, temperature rising as high as 140 degrees, according to the cloud density.

If it is necessary to raise the temperature still higher, the unit described has an electric booster element. The controlling switch may be manually operated, or fitted into the general scheme of an off-peak hot water system. When it is realised that it will be quicker to boost the 100 degree water to 135 degrees than it will be to boost from 50 to 135 degrees, we have the answer to the inclement weather question. (Heating water by other means will cost approximately 3/4d per degree F for a 60-gallon tank.)

The basis of operation of a solar heater is the application of the known fact that when heat is applied to a liquid the liquid expands, becomes lighter, and rises. In Figure 1, heat is applied to a container of water. The liquid nearest the flame expands, becomes lighter and rises, being displaced by the heavier, denser and cooler liquid around it. Cycle after cycle of these movements will continue while ever the flame is there. This constant motion is referred to as a "convection current."

USE FOR CONVECTION

In a solar water heater, this same "convection" system is applied once again. In Figue 2 (a) convection is to be initiated by applying heat in the form of solar radiation to an absorber. The tubes of the assembly are full of water, which when heated expands, becomes lighter, rises to the top of the absorber and is projected via the flow pipe to the upper portion of the storage tank. The path of convection goes through the

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water in the tank and returns to the bottom of the absorber via the return pipe. With the presence of sufficient solar radition this convection will continue uninterrupted until the water in the tank is as hot as that in the tubes of the absorber.

CORRECT LAYOUT

For correct operation the components must be arranged in a manner which will naturally promote convection current through the whole system. A good layout will pay a handsome dividend, whereas poor ratio of rise in the flow and return pipes will impede the operation of the convection. Although a variety of layouts can be made to work successfully, careful consideration must be given to this point to ensure good results. If we consider Figure 2 (b) it will be noticed that the absorber has been drawn on the same level as the storage tank. During periods of solar radiation, convection currents will be set up in the same way as in Figure 2 (a). But the downfall of such an arrangement is that the absorber might become a radiator the moment solar radiation ceases. Experiments have shown that this does undoubtedly occur when the absorber and the tank are mounted at the same level. The result of such a layout would be that all heat stored in the tank during the hours of sunlight would be transferred back to the absorber by reverse convection. The heat would be radiated away to no good purpose until the storage tank was as cold as the outside air. So it can be seen that not only must the layout provide for natural convection of heat to the storage tank, but also it must be arranged in such a way as to prevent reverse convection.

Reverse convection (or, more correctly, "reverse thermo syphon"), is usually brought about by heated water in the tank being able to penetrate back along the upper flow pipe at night. If the rise of this pipe is too shallow then the heat may travel right back to the absorber. Once this motion is created in the flow pipe, the whole body of the water in the tubes will also move in reciprocation. This reversing of the thermo syphon would probably be barely noticeable at the absorber, but if it were allowed to continue through the night it would be quite sufficient to dissipate most of the heat stored during the day.

RATIO OF RISE

More specifically the ratio of rise should not be less than one in five. The system has been known to operate up to one in ten, but the danger of intermittent thermo syphon would always be present at this figure. The ratio can be calculated by dividing the total length of BOTH the flow and return pipes by the height above the absorber at which the uppermost flow pipe enters the storage tank.

A variety of layouts can be used provided the ratio still comes within the safe working zone. Ideally, the tank should be as close as possible to the absorber, since long flow and return pipes will allow some of the heat to escape while the water is travelling to and from the tank. Provided good insulation is used, losses will not be serious up to 30 or 40 feet, but extreme distances should be avoided. (Note that a run of 30 feet would require the base of the tank to be at least 10 feet above the absorber.)

In a trial layout, the total length of both the flow and return pipes was made 48 feet. The thermo-syphone ratio was stretched to one in eight and the flow pipes were made to follow a variety of paths at different levels in an endeavour to find the critical point at which the thermo-syphon refuses to operate.

In Fig. 3 (a) the absorber flow pipes rose three feet in the first five feet, then ran truly horizontal for 16 feet before rising sharply three feet to the tank. Little or no convection resulted.

In Fig. 3 (b) using the same 48 feet of tubing and an overall rise of six feet, the tubes rose gradually all the way to the tank. Convection was immediately apparent.

RISE ALL THE WAY

In all the schemes tried those which employed the "rise all the way" layout were by far the most successful. Absolutely horizontal runs of more than two or three feet are to be avoided at all costs. If pipes must travel for any great distance horizontally then a rise of four feet or so must be employed to ensure that convection is maintained the whole year round.

Fig. 3 (c) shows a further change in layout of the one in eight thermo-syphon ratio. This scheme will work quite well but the horizontal run must not be too close to "true level."

In Fig. 4 the author's unit is shown with its relevant rises along the length of the flow pipes. Total rise is eight feet, total length of flow pipes 40 feet, ratio one in five. This unit gives a good output the whole year round, and is well worth consideration.

So much then for the layout of the unit as a whole. We must turn our attention now to the absorber box itself—the theory of its operation and the details of its construction. The problem is to extract heat from the sun's radiation in such a manner as to minimise subsequent loss of this heat by re-radiation, convection and conduction.

At first glance, prevention of such losses may appear to present a difficult problem. While well established insulation techniques may be employed to prevent loss of stored heat, it is obvious that these may also defeat the very object of the system since, in preventing heat from escaping, they also will prevent heat from the sun reaching the absorber.

SIMPLE SOLUTION

Fortunately, there is a very simple solution. Energy from the sun contains very little heat as such. Rather is it radiation in the light, ultra-violet, and infra-red regions. This is converted to heat when it is absorbed by any object.

It only remains then to find a material which is transparent to most of this radiation, but relatively opaque to heat radiation, in order to provide a "one-way" screen which will let the sun's energy in but not let the heat energy out. Glass possesses this characteristic to quite a high degree, some grades being better than others, but all being very suitable. Plastic, on the other hand, is quite poor.

In greater detail, we may state the situation as follows:

The heat emitted by radiating objects (including the sun) is in the form of bands of electro-magnetic waves which are identical in every way with light and radio waves. The actual wave lengths of the emitted radiations depend upon the absolute temperature of the radiating object and even though there is a BAND of wavelengths present, the maximum energy output will occur at one particular spot within the band.

GOOD AND BAD INSTALLATIONS

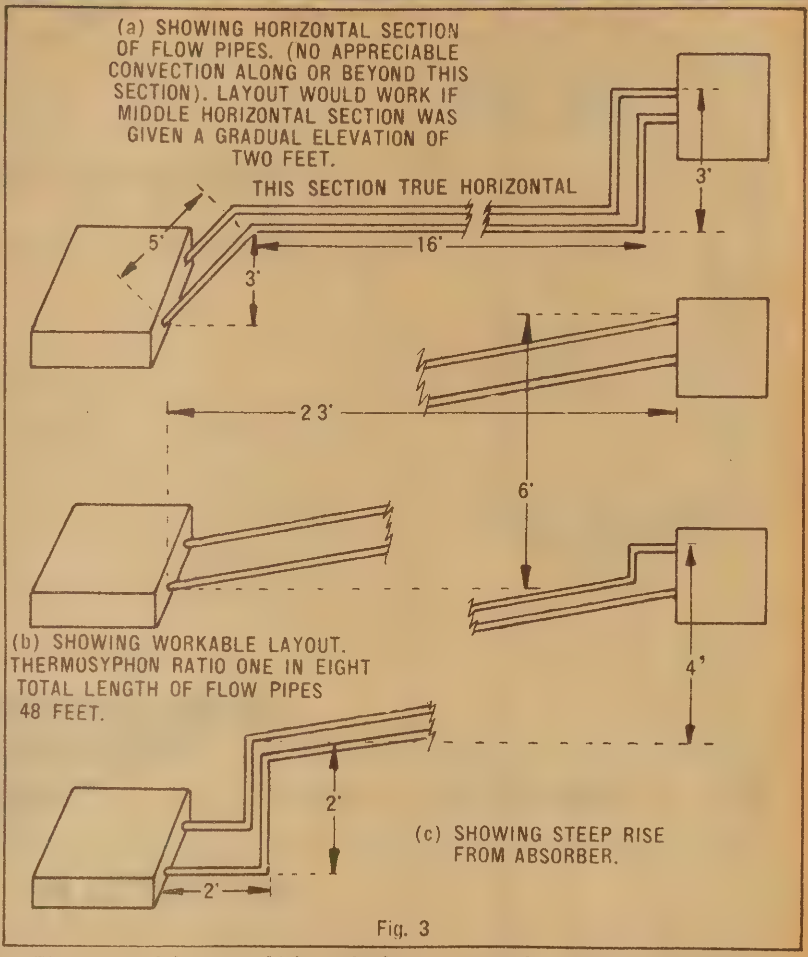
(a) SHOWING HORIZONTAL SECTION OF FLOW PIPES. (NO APPRECIABLE CONVECTION ALONG OR BEYOND THIS SECTION). LAYOUT WOULD WORK IF MIDDLE HORIZONTAL SECTION WAS GIVEN A GRADUAL ELEVATION OF TWO FEET.
THIS SECTION TRUE HORIZONTAL
5'
3'
16'
3'
2 3'
6'
(b) SHOWING WORKABLE LAYOUT. THERMOSYPHON RATIO ONE IN EIGHT TOTAL LENGTH OF FLOW PIPES 48 FEET.
4'
2'
(c) SHOWING STEEP RISE FROM ABSORBER.
2'

Fig. 3

Three typical layouts which might be encountered in practice. The one at (a) is least satisfactory due to the long horizontal section. Arrangements (b) and (c) are much more satisfactory.

It may be shown that the wavelength for maximum energy output is directly proportional to the absolute temperature of the radiating body. Thus, the higher the temperature, the shorter is the emitted wavelength.

The sun, for instance, whose surface is at a temperature of roughly 6,000 degrees K, radiates with peak energy in the region including visible light and a small amount of ultra violet and infra red. This is the region whose wavelengths lie between 0.3 and 2.5 microns. (A micron is one millionth of a metre.)

By comparison objects at temperatures usually met with in solar heating applications (100 to 200 degrees Fahrenheit) radiate with wavelengths in the vicinity of 8 to 10 microns. These radiations lie within that portion of the electromagnetic spectrum known as the infrared region which bridges the gap between visible light and ultra high frequency radio waves.

When a surface absorbs part or all of any radiation falling on it the energy contained in the absorbed radiation is given up in the form of heat.

In actual fact it is found that there are no perfect absorbers or reflectors of sunlight — the greatest absorption we can realise with a mat black surface is of the order of 92 per cent of incident radiation. Various colours have different ratios of reflection and absorption; a white roof for instance will reflect up to 78 per cent and a red roof about 31 per cent of the sun's heat.

TWO-WAY ACTION

It is also a fact that a good absorber is also a good emitter. For instance, if we heat a black and a white billiard ball to the same temperature and allow them to cool, it will be found that the black ball loses heat faster than the white. It can be shown that the difference in the rates of cooling is proportional to the difference in absorptivity of the two balls.

Another aspect of the same problem is that of transparency. We say that ordinary window glass is "transparent" because the whole range of sunlight passes through it with negligible loss. We are able to assess this quality for ourselves because our eyes are sensitive to the particular wavelengths involved.

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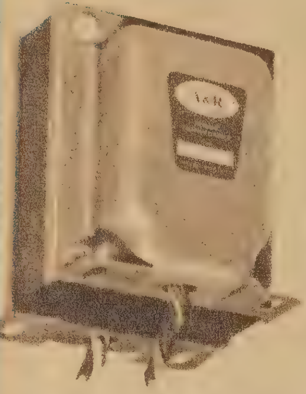

All voltages given are those obtained under fully loaded conditions. Maximum temperature rise 45°C, fully loaded. Attractively finished in baked Silver-Grey Hammertone with Black Cores.

The use of silicon diode rectifiers, particularly in voltage doubler circuits, enables more compact equipment design with reduced heat dissipation from transformer and rectifiers.

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Type No.	D.C. Output M.A.	D.C. Output Volts	A.C. Secondary Volts	Filaments		Effective R (See note*) Ohms	Weight		Overall Height inches	Mounting Dimensions inches	Base Dimensions inches	Mounting Type
				Volts	Amps.		lbs.	ozs.				
2062	80	290 265	115 TAP 105	6.3 C.T.–	2.25	25	3	2	3½	2⅛x2 5/16	2⅞x3	VLN 31
2063	80	340 315	135 TAP 125	6.3 C.T.–	2.25	29	3	3	3½	2⅛x2 5/16	2⅞x3	VLN 31
2064	125	340 315	135 TAP 125	6.3 C.T.– 6.3.–	2.25 2.25	16	4	15	3⅞	2½x2 9/16	3½x3 5/16	VLN 34
2065	150	290 265	115 TAP 105	6.3 C.T.–	6	10	5	10	3⅞	2¾x2 9/16	3¾x3 5/16	VLN 34
2066	190	320 265	125 TAP 105	6.3 C.T.–	6	7	6	8	3⅞	3x2 9/16	4x3 5/16	VLN 34

Note* — Effective Transformer Series Resistance referred to Secondary

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Type No.	Inductance at Rated Current Henrys	D.C. mA.	Resistance Ω	Maximum Direct Working Volts	Weight		Mounting Type	DIMENSIONS BASE		
					lb.	oz.		Mounting	Overall	Height
3040	12	100	290	600	1	7	SCL 22	3 1/16	3 9/16 x 1¾	2¼
3041	12	125	275	600	2	0	SCL 22	3 1/16	3 9/16 x 2¼	2¼
3042	12	150	205	600	2	6	VLN 25	2 x 1¾	2⅝ x 2½	3⅛
3043	12	175	185	600	3	3	VLN 25	2 x 2¼	2⅝ x 3	3⅛
3044	12	200	165	600	4	4	VLN 31	2 5/16 x 2½	3 x 3¼	3½
3045	10	250	130	1000	5	2	VLN 34	2½ x 2½	3 5/16 x 3½	3⅞
3046	10	300	90	1000	6	11	VLN 34	2½ x 3	3 5/16 x 4	3⅞
3047	5-15	250-50	70	1000	5	4	VLN 31	2 5/16 x 3	3 x 3¾	3½

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However, when we use detectors which are sensitive to radiations outside those of visible light we find that the same glass is quite opaque to large sections of the infra red regions.

When radiations, with wavelengths extending beyond about 2.5 microns, fall on the surface of glass, they are almost totally absorbed in its surface. The absorption results in a heating of the glass surface but because glass conducts heat so poorly there will be very little rise in temperature of the side of the glass remote from the incident radiation.

PRACTICAL PROOF

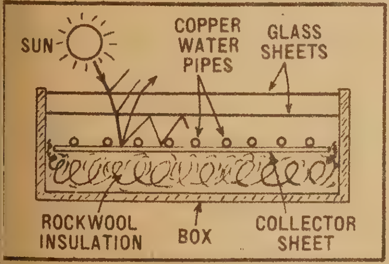
To demonstrate some of these theoretical assertions conclusively, a series of three experiments was conducted. First, a small absorber box was constructed, measuring six inches by five inches, well insulated internally, and with two sheets of glass on one side, one of which was easily removable. Inside the box was a strip of sheet copper and a thermometer.

In all, three separate fact-finding observations were made.

For the first experiment, temperatures were taken inside the box both with and without the outer sheet of glass. The results are listed in the table below. It should be noted that there was very little variation in the shade temperature throughout the day.

Shade temperature	Still Air Temp. using one sheet of glass.	Still Air Temp. using two sheets of glass.
63 deg. F	133 deg. F	145 deg. F
65 deg. F	140 deg. F	150 deg. F
65.5 deg. F	142 deg. F	153 deg. F
66 deg. F	150 deg F	160 deg. F

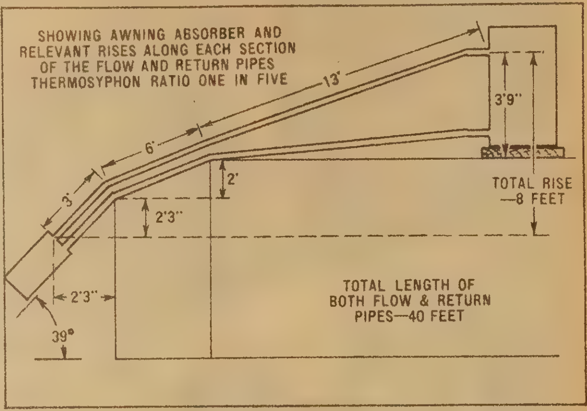
Further tests were then carried out. Each time the outer sheet was removed a fan blowing cold air was brought to bear on the surface of the inner glass, whereupon the temperature dropped rapidly. Each time the outer sheet was replaced — the fan still projected on to it — little or no temperature drop was recorded.



Cross section of an absorber box showing basic principles. Glass admits sun's energy, but retains heat.

This observation was continued throughout the whole dav and the point proved over and over again. Even in the failing heat at 3.20 p.m. on an August day, the hot still air maintained its temperature while ever the outer sheet was in position. Remove it and the temperature would drop several degrees, replace it and the temperature would rise again. At 4.30 p.m. the sun was not far above the horizon and the hot air in the box was losing 7 deg. every 10 minutes. However, upon removing the outer sheet the drop was 17 deg. in the next 10 minutes.

The second experiment involved placing the box and a bare thermometer close to an electric radiator. The uncovered thermometer rose by 65 deg. in a very short time, the thermometer in the box, however, rose only 14 deg. F, showing once again that heat is insulated to a great degree by glass and still air. In this particular experiment only 1in cf still air insulated the thermometer in the box which, incidentally, was 3in closer to the radiator than the bare one.


SHOWING AWNING ABSORBER AND RELEVANT RISES ALONG EACH SECTION OF THE FLOW AND RETURN PIPES THERMOSYPHON RATIO ONE IN FIVE
13'
6'
3'
3'9"
2'
2'3"
2'3"
39°
TOTAL RISE —8 FEET
TOTAL LENGTH OF BOTH FLOW & RETURN PIPES—40 FEET

☆

The author's own layout, showing a rise of some degress over its entire length. It is very effective, in spite of the length of flow pipes.

☆

The third observation was designed to show that solar radiation actually penetrates this still air blanket without any appreciable loss in intensity.

A cold, miserable and cloudy day was selected to emphasise the findings. Air temperature was 45 deg. F, little or no breeze was apparent and the sun was indiscernible behind a heavy layer of cumulo-nimbus.

The bare thermometer and the box were placed in a position where the sun, if it were shining, would have beamed upon both. After five minutes the bare thermometer moved up .05 deg. but the box temperature had moved up 10 deg. After 10 minutes the bare one moved up 1 deg. but the box had moved up 20 deg.

With little variation of the cloud formation the bare thermometer only reached 55 deg. at midday. The box however had climbed to 110 deg.

With regard to the materials in the absorber box, we are primarily interested in their ability, or not, to transfer heat; that is their conductivity. This is assessed by measuring the quantity of heat transferred in unit time through a block of the material under consideration.

When the particular block under test is a cube of 1cm side, and the temperature difference between front and back face is 1 degree C, then the quantity of heat transferred in 1 second is known as the Coefficient of Thermal Conductivity.

Copper, which is a material generally used in solar absorbers, has a coefficient of 0.92. This degree of conductivity is remarkable when it is considered that a piece of iron, of similar dimensions, will only transmit 0.16 calories in the same time. Glass is even poorer, having a coefficient of only 0.002 whilst that of still air is lower again at 0.000057.

Now, having considered some of the basic ideas involved, we can examine one possible design for a solar absorber for the heating of water. A schematic diagram is shown on this page and is to a large degree self-explanatory.

The box is generally made from wood, since this is a convenient material and a good insulator. Other materials may be used and will be discussed in the constructional description next month.

ABSORBER PLATE

The absorber plate is a sheet of copper, blackened to increase its absorption, and the network of water pipes is fastened securely to this to provide the most intimate possible contact. It should be noted that copper, as well as its excellent heat conductivity, is also most suitable as a long lasting water pipe, showing very little tendency to corrode.

The plate is insulated on the underside with conventional heat insulating material, and above by means of two sheets of glass and the air trapped between them.

Sunlight enters the box via the glass

(Continued on Page 127)

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144 Mc 3 ELEMENT MOBILE BEAM

by Keith Jeffcoat VK2BK

As promised last month, we are following the description of the four element "home station" beam, with details for a three element mobile beam. It is simple to construct, and employs an ingenious method of fitting to a car which avoids drilling or othwise mutilating the bodywork in any way.

THIS mobile beam will enable you to take part in VHF outdoor activities, such as "fox hunts" and field days, and also to engage in amateur activities while taking the family out for a picnic. Also, if you plan a travelling holiday, a mobile setup enables you to contact local amateurs as you pass through various districts.

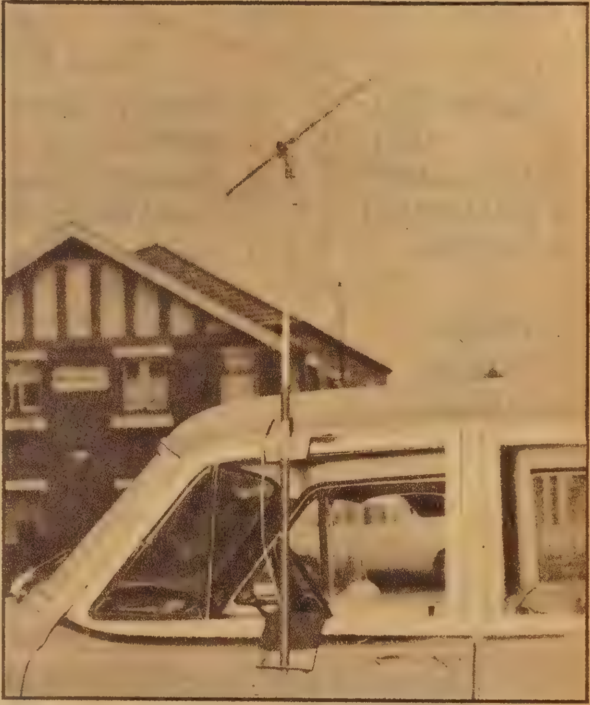
As we explained last month, the number and spacing of the elements is the main factor governing the impedance of the beam, and it is necessary to ensure that this value will be a convenient one for use with readily available commercial cables. For a number of reasons, 75 ohms is much favoured for this work, and our design is based on this figure.

Many experiments have been carried out by two metre enthusiasts and tests show that, with a three element beam, a spacing of .15 of a wavelength (12 inches) between radiator and reflector, and a spacing of .2 of a wavelength (16 inches) between radiator and director, will give us an impedance of 75 ohms at the centre of the folded dipole.

☆

The complete beam, mounted on the car and ready for a day in the open. Note the two brackets which support the beam and simply slip over the top of the door and window ledge. Felt pads protect the duco and there is no need to damage the bodywork in any way.

☆



This gives us a 1:1 match when we use standard coaxial cable for a feedline.

Accordingly, we have cut the three element beam to these dimensions. The folded dipole (radiator) is 38 inches long, its component parallel dipoles set with their centres exactly half an inch apart.

The reflector is 40 inches long and spaced one foot (centre to centre) from the radiator; the director is 36 inches long and spaced 16 inches (c. to c.) from the radiator.

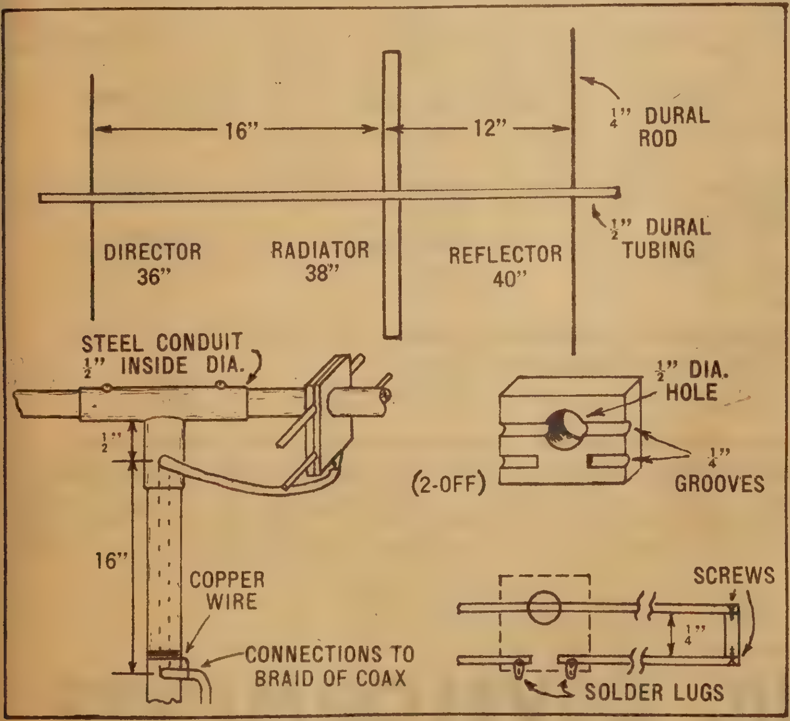
To make the beam, take a length of half-inch dural tubing 30 inches in length. This will be the boom. From one end, drill quarter-inch holes at a distance in of one inch, 13 inches, and 19 inches. The last hole should come out one inch from the other end of the boom.

DURAL TUBING

The elements are cut from lengths of quarter-inch dural tubing, and slipped through their appropriate holes. They are held in place by self-tapping screws or by one-eighth nuts and bolts, the holes for which must be very carefully drilled through the boom and the element so as not to weaken the antenna.

The lower dipole is attached to the ends of the top dipole by means of quarter-inch spacers and one-inch nuts and bolts, or by self-tappers screwed into a solid piece of metal one-quarter of an inch thick.

To hold the dipoles apart at the centre, we cut out two square pieces of perspex, with a half-inch diameter hole near the top, and quarter-inch grooves run-



This drawing should provide all the dimensions and constructional details necessary to complete the beam. The drawing at lower left shows details of both the "T" section to mount the boom on the mast, and how the mast is used as a 1:1 matching balun.

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25. " 4
26. " 5
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28. " 7
29. Transistor 8
30. R. T.V. & H. Transistor 8
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33. Transistorgram 7
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ning parallel top and bottom. (See the diagram of this.)

These perspex pieces slip over the boom, and clamp in position at either side of the folded dipole. The lower groove is interrupted at the centre, insulating the two ends of the lower dipole from each other.

Solder lugs are clamped around the ends of the dipole, and these extrude from between the bottom of the two pieces when they are clamped together. The feedline is soldered to these solder lugs.

The three-element beam is supported by a vertical shaft, also of half-inch dural, which fits into a socket made from half-inch inside diameter steel conduit. (This is also shown in the diagram.)

A hole, half an inch in diameter, is made at the centre of a three-inch length of the conduit, and another three-inch length is welded to it. This makes a T-shaped socket. The boom of the beam passes through the horizontal part of the T, and the support shaft fits up inside the vertical part of the T.

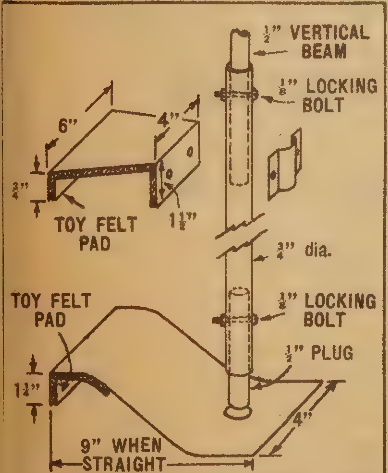
Self-tapping screws are then tightened to lock the boom and the support shaft together in the T-socket.

CAR FITTING

A three-element beam like this can be mounted on a car by means of a home-made fitting. This consists of a vertical pipe and two clamp pieces. The bottom clamp is pressed into the driver's door beside the rolled-down window. The top clamp fits over the top of the door, and is held firmly in place when the door is closed.

The unit can be fitted and removed n a few seconds.

The portions of the clamps which ome into contact with the car should be covered with toy felt to protect the duco. We have used this clamp for several years and have never made a mark on the car duco. The great advantage of this unit is that there is no need to drill any holes in the car chassis.



This drawing gives details of the supporting mast and the two brackets used to fasten it to the car. Note the felt pads to protect the duco.

The two clamps hold a vertical pipe vhich is three-quarters of an inch in liameter and two feet long. The vertical upport shaft of the three-element beam its down inside this pipe for a distance of about six inches, and is then locked into place by means of a one-eighth nut and bolt. This allows the beam to clear the roof of the car by at least two feet.

At the bottom of the pipe is a plug made of half-inch dural, about three inches long, similarly locked in place with a one-eighth nut and bolt. The half-inch plug protrudes one inch from the bottom of the pipe, and fits through a half-inch hole in the bottom clamp.

It fits tightly enough to hold the beam steady in any selected direction, yet may be turned by hand to tune in various signals.

This fitting was made up for a Holden station sedan, but also fits quite nicely on two well-known makes of British car. You may have to alter the dimensions slightly to fit your own vehicle.

FEEDLINE

Finally, there is the question of feeding power to such an aerial. A basic requirement is that the cable used should have a characteristic impedance equal to the impedance at the centre of the dipole—approximately 75 ohms in this case.

Practical cable takes two forms; twin feeder and co-ax. Twin feeder makes a "balanced line," neither side of the circuit being "earthy," while co-ax makes an "unbalanced line," the outer conductor being deliberately earthed.

This latter arrangement has a number of advantages. The earthed outer shield renders the system relatively non-critical, in regard to large masses of metal, such as car bodies, etc. Thus, moving the beam does not unduly upset performance. Also, co-ax is less affected by rain and salt spray, which cause serious losses in twin ribbon feeder.

Another factor is cost and availability. Taking into account disposals stocks, 75 ohm co-ax is a good deal more plentiful and cheaper than 75 ohm twin ribbon. Hams, being what they are, make the obvious choice.

The only disadvantage—and it is not a serious one—is the need to convert from the unbalanced line to a balanced line in order to feed the aerial correctly. Last month, we described two 1:1 baluns for this purpose, and one of these is particularly suited to this beam. It makes use of portion of the supporting mast as a quarter wavelength sleeve over the co-axial line.

DRAWING

A drawing of this was shown last month, but we are incorporating it again in the detail construction drawing this month. Briefly, it requires that two holes be drilled in the mast, 16 in apart, and the top one approximately half an inch from the bottom of the boom. The co-ax passes into the sleeve (mast) through the upper hole and out again through the lower one, the braid of the co-ax being securely bonded to the sleeve at this point.

And that is about all there is to it. It is a simple project, and anyone reasonably handy with tools should be able to knock up a reasonable copy without much effort. Provided the essential dimensions of the beam are retained, there is no reason why considerable liberties may not be taken on the mechanical side to suit tools and materials available. So go to it, and good hunting.

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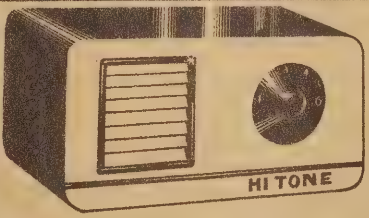

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TRANSISTORS—WHY THEY AMPLIFY

This is the first of a series of articles prepared for their servicemen by the *Delco Radio Division of the General Motors Corporation. Although this first article retraces some familiar ground regarding the nature of the atom, it leads naturally into Part Two which deals with current conduction through semi-conductor solids.

PART 1

A NEW era in electronics is gradually developing. The transistor, discovered in 1948 by Bell Laboratories and named for the two words "transfer resistance," already has significantly influenced the design of electronic devices.

Although smaller, more rugged, and requiring less operating voltages than the valve, the transistor in many cases can perform the same functions with better efficiency.

The transistors that are now on the market, and those that will soon be made available, are varied in size and appearance. Some voltage amplifier type transistors will be very small while the power gain type transistors will be somewhat larger.

The transistor is certainly here to stay; improving many of our existing types of equipment and lending itself to be used in other equipment never before employing electronic devices.

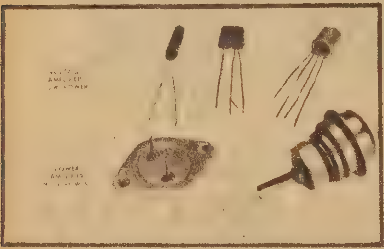

Fig. 1. Voltage amplifier transistors may be made very small, but power output types are somewhat larger.

In the motor car for example, the transistor is ideally suited because it requires only 6 or 12 volts for operation—voltages readily available in any car.

AUTOMOTIVE APPLICATIONS

For this reason, it is not too difficult to visualise many other applications for transistors in tomorrow's car. For automatic headlight dimming, electronic braking devices, electronic ignition and starting systems for the higher compression engine, and even electronic steering where the driver may be able to read a book, eat his lunch, play a game of cards, or just converse with his friends without worrying about the actual driving of the car.

The compact transistorised car television set may some day become almost standard equipment. The portable radio will become even more portable, fitting into the palm of the hand or being worn on a strap as we do a wrist watch.

The application of the transistor in industry where electronic control devices are used may make these devices even more popular than they are today.

Due to its high dependability, the transistor will be used in controls for safety, navigation, and many other applications in the world of transportation.

And now, let's compare the transistor to the old faithful valve which we have known so well and worked with for years.

Much space in an electronic unit can be gained by the use of transistors in place of valves. Figure 3 shows a comparison of the size of the transistor to a valve which is currently used for the same application.

The low power transistor (voltage amplifier) is designed to replace the low power valve, and the power transistor will do the job of the power amplifier valve.

NATURAL CHOICE

In many applications, this size reduction is of maximum importance. The transistor has been used in hearing aids for quite some time now, since a hearing aid must be kept very small, and the transistor conforms well to this size limitation.

The transistor will operate with a much lower current drain than the valve.

A great deal of this is due to the fact that the transistor does not have a filament, and as we all know, in most valves the power required to heat the filament is many times more than the power that is realised in the useful, job-doing portion of the valve.

This feature alone is of great value for use in portable electronic equipment, since the battery life will be greatly increased. Unlike the valve, the transistor can operate on extremely small voltages. Whereas most valves must have a plate supply in the neighbourhood of 250 to 350 volts, the transistor can operate directly from a low voltage battery supply.

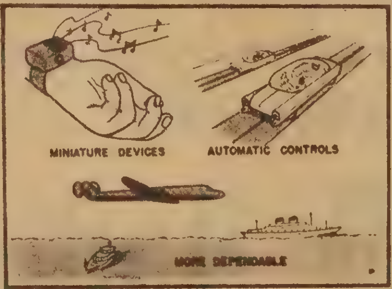

Fig. 2. Transistors make possible many things which were only science fiction 10 years ago.

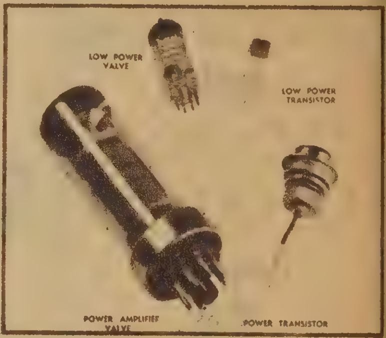

Fig. 3. Comparison between amplifier and power valves, and the equivalent transistor types.

Since both the operating voltage and current drain of the transistor are much lower than that of valves, it is logical to assume that the battery supply in a transistorised unit can be greatly reduced.

Again we can see that this low voltage, low current feature of the transistor will open many more doors to the use of electronics than we have enjoyed in the past.

There are many types of transistors that can be made available; however, up to now, the two most popular types have been the point contact and the junction transistors, Fig. 4.

POINT CONTACT TYPE

In this illustration we see the general make-up of a point contact type transistor and we see that it consists of a pellet of germanium upon which two cat-whisker type leads have been affixed.

This type transistor was actually the first type developed, but has lost much of its popularity due to manufacturing difficulties. The operation of the point contact type transistor is very dependent on the physical spacing between the two cat-whiskers.

This, coupled with the fragility of the cat-whisker contacts, makes it an extremely difficult production problem.

The type of transistor in more common use today is the junction type transistor. As can be seen in Fig. 4, the junction type transistor consists again of three parts, a germanium wafer and two metallic discs. Leads attached to the metallic discs which are diffused into the germanium wafer become electrodes of the transistor.

The junction transistor is far more stable and rugged than either the point contact type transistor or the valve, and

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ATOM & SOLAR SYSTEM COMPARED

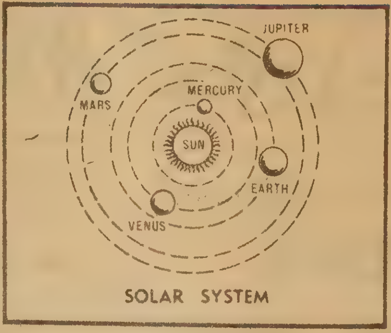


Fig. 5. Our solar system consists of a central body (the sun) and a number of smaller bodies (planets) which revolve around it in definite orbits.

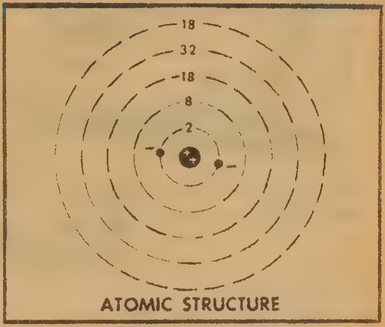


Fig. 6. Similarly, the atom is believed to consist of a central body (the ucleus) and a system' of atoms which revolve around it in definite orbits.

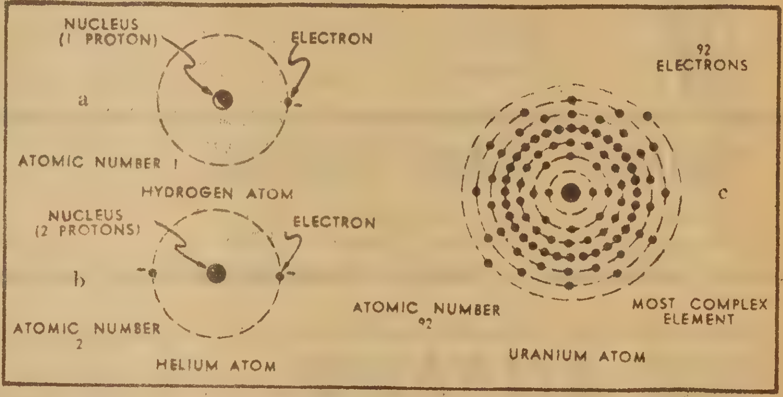


Fig. 7. At (a) we have the simplest atom, hydrogen, at (b) another simple atom, helium, anb at (c) the most complex atom, that of uranium.

s fast replacing certain valves in radio and electronic applications.

The chief difference between a transistor and a valve is that the current carriers (electrons) in a valve flow through a vacuum but the current carriers (not always electrons) in a transistor must travel through a solid material.

Therefore, it will be necessary to examine more closely the physical make-up of germanium and the other types of metal used with it, in order to understand how a transistor works.

For many years, scientists have studied the solar system and for about as many years we have maintained the theory that the atomic structure of matter is very similar to that of the solar system.

As Figure 5 shows, in our solar system the planets revolve about the sun in certain orbits. Of course, no two planets spin around the sun in the same orbit. We can see then that the sun and its planets constitute a family. This same type of family exists in the make-up of matter; we call it an atom.

ATOMIC STRUCTURE

Since the basic structure of matter is the atom, let's take a look at one of them. Very much like our solar system, an atom is made up of a nucleus around which a certain number of electrons will rotate.

There are certain rules governing the orbits of these electrons in that the first ring away from the nucleus will have a maximum of two electrons travelling in that ring. The next ring or orbit will have a maximum of eight electrons. The next ring will have a maximum of eighteen, the next will have a maximum of thirty-two, then eighteen again and so on.

When the outer ring or orbit of an atom contains the maximum number of electrons it is a stable material. These electron rings are very important in the study of electricity, since it is the make-up of these rings that determines if an element will conduct electricity or not.

Now let's consider examples of atoms of some of our basic elements.

Figure 7A shows an atom of hydrogen which is the simplest form of matter known. You will notice that it has a nucleus with one proton in it and one electron travelling around this nucleus in the first orbit.

The atomic number of hydrogen is one since it has only one electron and one proton.

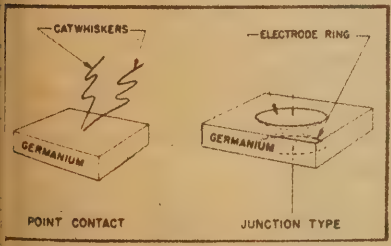


Fig. 4. Two common types of transistor construction. The point contact type is now less common than the junction typs.

As we all know, hydrogen is a gas and is much lighter than air and at one time was used extensively for inflating balloons. Hydrogen is not stable and combines readily with oxygen, making it unsafe for this use, and a switch was made to the use of helium in balloons.

In Figure 7B, we see that helium consists of a nucleus and two electrons revolving around this nucleus. You'll notice that both of these electrons are in the same ring. Helium is known as an inert gas since its outer ring is complete.

The atomic number of helium is two.

The difference between one element and another lies in the number of electrons revolving around the nucleus of the atoms of the different elements. Another basic difference lies in the number of neutrons, neutral electric charges, that lie in the nucleus with the proton. Now, let's consider the most complex element, uranium.

ELECTRON ORBITS

The atomic number of uranium is 92. This means that the nucleus of the uranium atom will have 92 electrons rotating about it in different orbits or rings.

You'll notice that the first ring has two electrons in it, the second ring has eight, the third ring 18, the fourth ring 32, the fifth ring 18, the sixth ring 12, and the outer ring will have two electrons in it.

As we mentioned, this is the most complex of the elements.

All the basic elements will have a number of electrons rotating around their nucleus varying from the hydrogen atom having one electron to the uranium atom which has 92 electrons.

We have now talked about the basic structure of matter, so let's take a look at this structure from the standpoint of conduction of electrical energy.

The ability of an element to conduct electricity is dependent upon the number of electrons in the outer ring of an atom of that element.

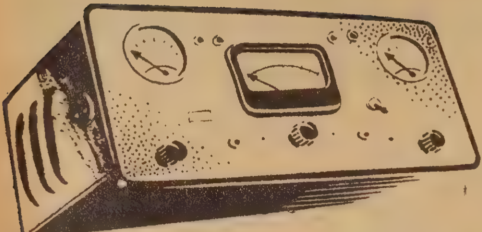
OUTER ORBITS

Any of the two outer rings can be incomplete since the numbers indicated are the maximum number of electrons that will be found in that ring. All outer rings are considered complete if there are eight electrons present there.

Elements which have a nearly complete outer ring will not readily conduct electricity. These outer ring electrons of a nearly completed ring are held more tightly to the nucleus than those of an element where the outer ring is less complete.

In an atom of an element which has only one, two or three electrons in its outer ring, these electrons are not tightly bound to the nucleus. In these atoms, the outer ring electron can be moved from one atom to another, by means of the application of a difference of potential.

In conduction, we are primarily interested in the metallic elements such as iron, copper, silver, aluminium, etc. All



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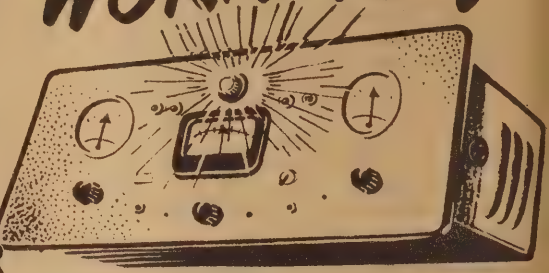

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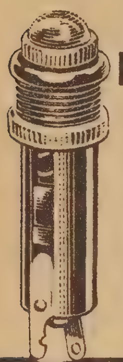

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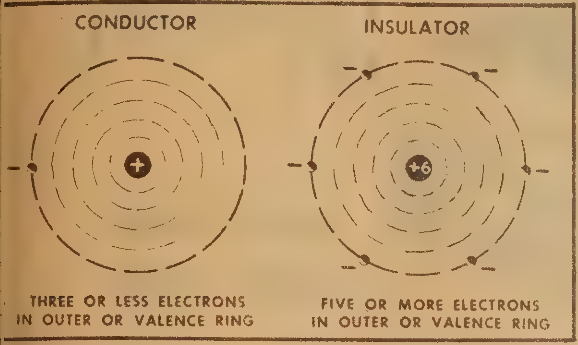
f these elements are considered conuctors because their outer ring has only ne, two or three electrons in it.

Any element that has five, six or ven electrons in its outer ring will not a good conducor of electricity and is ferred to as an insulator.

It takes a tremendous difference of otential applied to this material to cause e electrons to be broken from the uter rings and constitute current flow.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THREE OR LESS ELECTRONS IN OUTER OR VALENCE RING
FIVE OR MORE ELECTRONS IN OUTER OR VALENCE RING

☆

Fig. 9. Materials with three or less electrons in the outer ring behave as conductors. With five to eight in the outer ring, it will be an insulator.

☆

Considering Figure 9A, we can analyse n atom of a good conductor. You will otice that in the outer ring of this om, there is only one electron. That lectron is held to the nucleus very osely and the application of a difference of potential will force this electron way from that outer ring from where it ill travel to the next atom.

This movement of electrons from om to atom gives us current flow.

In the atom of an insulator shown in igure 9B, the electrons in the outer ng of this atom are more tightly held the nucleus because the number of ectrons in this outer ring approaches at of eight which can be considered the umber of electrons required to comete an outer ring.

No element will be found with more ian eight electrons in its outer ring. nce these outer ring electrons are held ghtly to the nucleus, it is easy to see at the difference of potential that must applied to move these electrons is uch greater than that of a conductor. or that reason, we call this an insular.

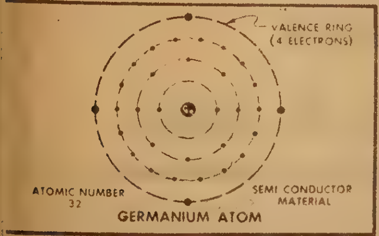

Fig. 10. The germanium atom, with four electrons in its valence ring, is mid-way between a conductor and an insulator, i.e., a semi-conductor.

Of course, any insulator will conduct ectricity if a high enough voltage presre is applied to it.

In Figure 10, we see a representation an atom of germanium. The atomic imber of germanium is thirty-two; this eans that it will have four electron ngs of two, eight, eighteen, and four spectively.

Germanium has the unique properties at under certain circumstances it will be a conductor, but not a good one; and under other conditions it will be an insulator. At the lower temperatures, germanium is an insulator, and at higher temperatures germanium acts something like a conductor. For this reason, germanium is known as a semi-conductor.

Germanium is one of those elements which, because it has only four electrons in its outer ring, has an affinity for combination with other atoms whose outer rings are also incomplete.

The outer ring of an atom is called its valence ring. If a number of atoms of germanium are joined together into a crystalline form, we have what we call co-valent bonding.

CO-VALENT BONDING

In crystalline germanium, the valence electrons or outer ring electrons of each atom will combine with electrons in the outer ring of adjacent atoms, and, with the two valence rings of the atoms joined, form co-valent bonding.

If we look at the nucleus of one of the germanium atoms, we see that instead of having four electrons in the outer ring, it now has effectively eight, with each atom having exactly eight valence electrons, instead of the original four.

This bonding of electrons makes the material a very good insulator.

In Figure 12, we see an atom of germanium and an atom of antimony. You will notice that for simplification reasons, it shows only the nucleus and the outer or valence rings of each atom.

As we have seen before, the valence ring of the germanium atom has four electrons in it. The outer ring of the antimony atom has five electrons.

If we add a very minute amount of antimony to crystalline germanium, we find that the antimony atoms will distribute themselves throughout the structure of the germanium crystal. Let's consider what takes place in this germanium crystal.

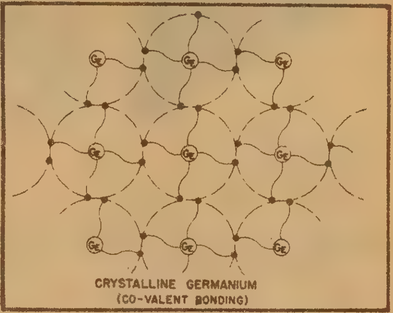

Fig. 11. The structure of crystalline germanium. Valence electrons combine in what is called co-valent bonding.

In Figure 13, we are looking at an area of the germanium crystal where an atom of antimony is located. Note that the antimony atom, with its five valence electrons, has gone into co-valent bonding with its germanium neighbours, but in doing so, has one electron left over.

In other words, the antimony atom will form complete co-valent bonding with the germanium atoms, but for each

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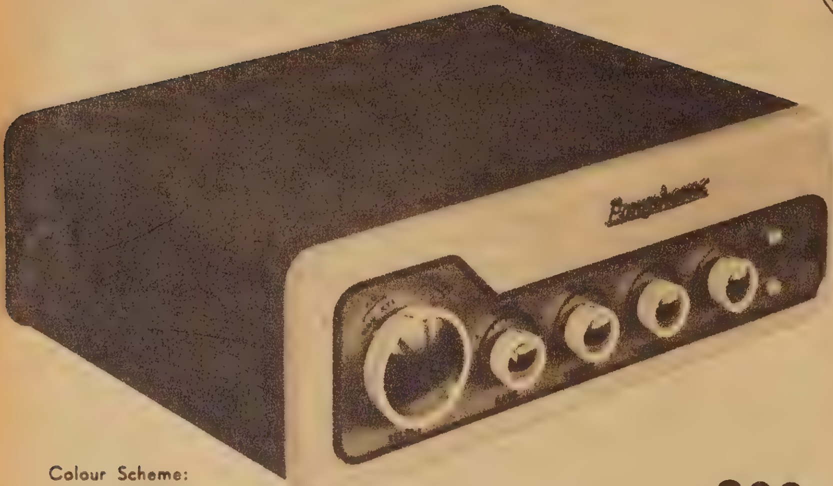

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antimony atom present, we will have an excess of one electron in the material which doese not enter into co-valent bonding.

Thus, each antimony atom in the material donates a free electron, and multiplied by millions of antimony atoms, enough electrons are obtained to support current flow through the material.

The antimony is called a "donor" since it donates free electrons, and the germanium crystal now becomes N-type germanium (negative type) because of the presence of these electron current carriers.

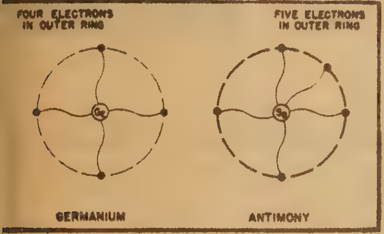

Fig. 12. Simplified representations of germanium and antimony. Antimony is one of the impurities deliberately introduced into germanium.

It must be pointed out that the antimony impurities are added in extremely controlled amounts, because if the number of conduction electrons becomes too great, the material then becomes simply a good conductor.

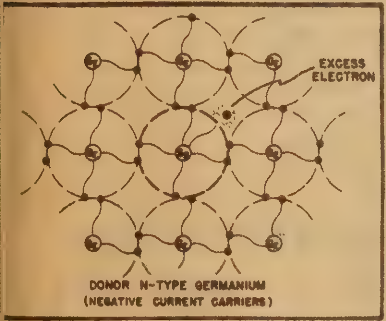

Fig. 13. The atomic structure of germanium when a small quantity of antimony is added.

Other factors which would increase the number of conductor electrons beyond the usable range are moisture and heat sufficiently high to cause electrons o leave their bond. Later it will be hown what methods are taken to pro-ect a crystal against these factors as much as possible.

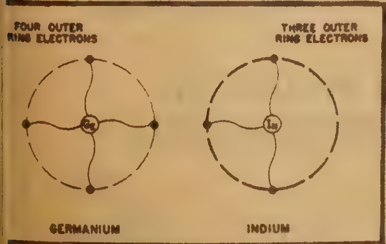

Fig. 14. The structure of germanium and indium. Compare with fig. 12.

We have now established a germanium crystal which has some conduction electrons dispersed throughout it. Since these electrons have a negative charge, we can now call this material N-type material or donor material.

Now we will compare the indium atom to the germanium atom. As we know, the germanium has four valence electrons in its outer ring. The indium atom has only three electrons in its outer ring.

Here again, indium is another element that will enter into co-valent bonding with germanium, in which case, the outer ring electron of each atom will be shared by the outer ring electrons of a neighbouring atom.

Let's see what takes place when a controlled amount of indium impurity is added to a germanium crystal.

The atoms of indium will distribute themselves throughout the crystalline structure of the germanium.

Since the indium atom has only three valence electrons compared to germanium's four, co-valent bonding will occur between the two atoms. However, for every indium atom in the material, we will have a deficiency of one electron

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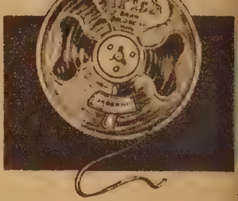

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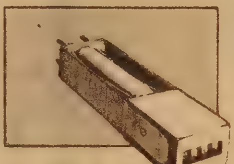

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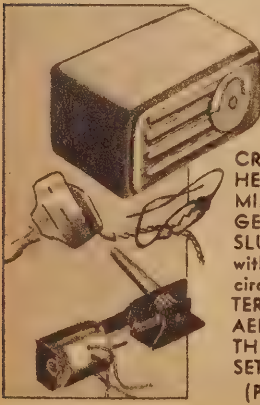

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at is needed to complete co-valent nding between the two elements.

Since this atom or combination of oms will have an affinity for an elecon to complete its co-valent bonding, can say that we now have a hole. other words, a hole can be defined a deficiency or a lack of an electron, d represents a minute positive charge.

You can easily see that this type of aterial will readily accept an electron complete its co-valent bonding and we erefore can call it "acceptor" material. nce the hole will be the current car- r in this type of material, this is P- e germanium.

The hole can effectively be moved

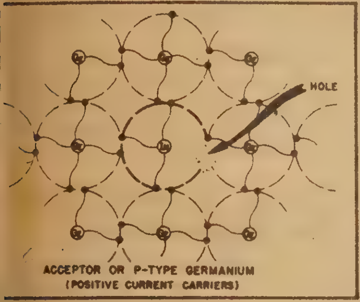

Fig. 15. The effect of adding indium to germanium, compare with fig. 13.

om atom to atom the same as an elecn can be moved from atom to atom.

In Figure 16, the indium atom has en moved over to the left a little to w more of the germanium atoms in crystalline structure. When this ype germanium crystal was produced, hole appeared in the outer ring of indium atom, since it had only three ctrons, to combine in co-valent bond- .

If a difference of potential were to be

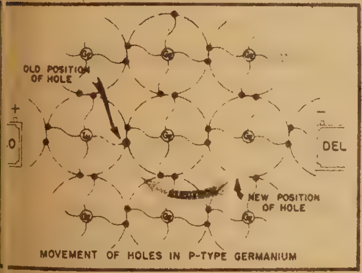

Fig. 16. The migration of "holes" n P type germanium. Holes move in the opposite direction to the electrons.

plied to this material there would a tendency for an electron to be forcfrom right to left due to the influe of this voltage.

The negative potential on the right uld repel an electron towards the left l the positive potential on the left uld attract an electron. In this case, of the electrons in the outer ring one of the other germanium atoms l be dislodged and will travel over to indium atom, filling up the hole. ectively now, we have had hole vement from left to right.

n other words, the hole can be said have travelled from the indium atom the right to the germanium atom, ce the hole now appears at that point.

(To be continued next month.)

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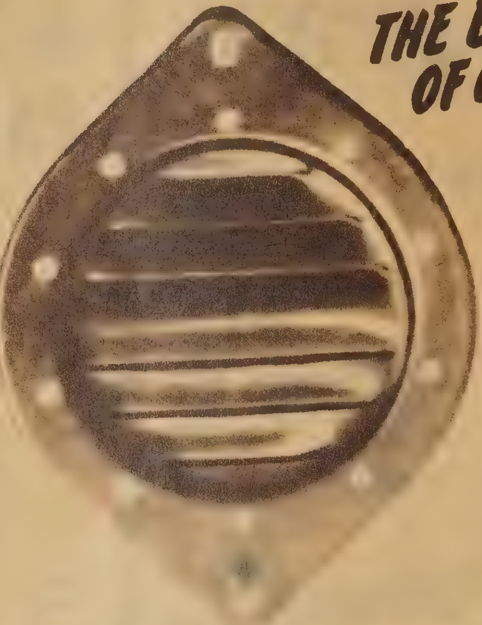

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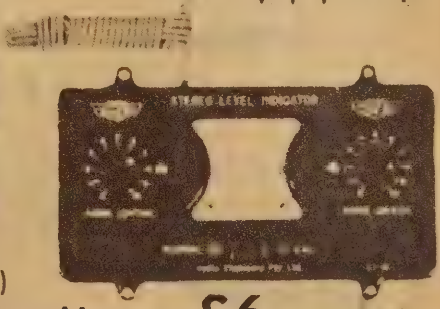

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. . . The WARBURTON FRANKI Page

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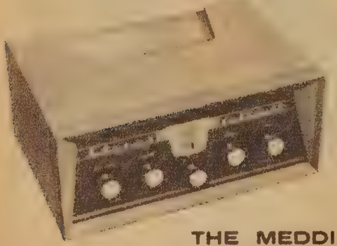

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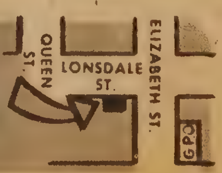

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A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

A SIMPLE SIGNAL TRACER FROM SPARE PARTS

Signal tracer, audio amplifier, test loudspeaker and output transformer are available in a simple test instrument constructed by a N.S.W. reader. He says that it has proved a very useful device for radio repair work on an amateur basis.

HOUGH the unit can be built up to suit individual requirements, the mensions of the original were kept irly small in the interests of portability.

It was built into a box measuring 7in de, 6in high and 5in deep.

The circuit is shown herewith. Alough it is open to criticism in certain tails, our correspondent claims that it eets his requirements very well. In y case, given the basic idea, other aders may care to experiment further.

The main function of the instruments controlled by the 3-position multipole itch S2.

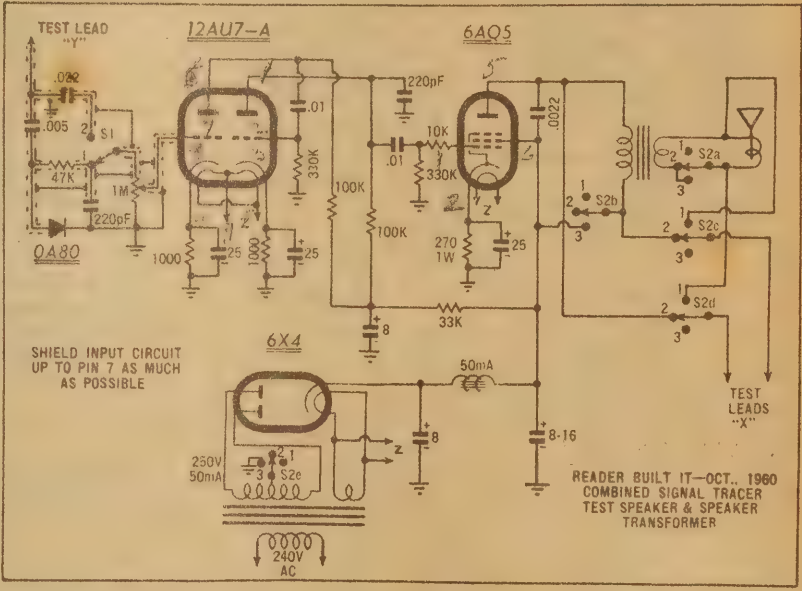
In position 1, the test leads marked " are connected across the loudspeaker ice coil so that it is immediately available to use with external amplifiers.

In position 2, the test leads connect, stead, to the primary of the output nsformer, so that this can be clipped ross the terminals of a transformer in her equipment, which is open circuited.

MPLIFIER OR TRACER

Position 3 disconnects test leads "X" d introduces the audio amplifier, owing the unit to function simply as amplifier or as a signal tracer.

A point of criticism is that, with the itch set to other than position 3, volte would be applied to the screen but t the plate of the output pentode. This could lead to rapid valve failure. Our suggested modification is to include S2e, which interrupts the HT supply on positions 1 and 2, avoiding this difficulty.



Basically, the unit is a high gain audio amplifier plus a simple detector. Almost any similar combination of valve types could be used with appropriate changes in circuit values.

When used as a signal tracer or audio amplifier, input is via test lead "Y." For RF circuits switch S1 is set to position 1, while, for audio, it is set to position 2.

Though simple, this input circuit could be criticised on the grounds that it will load rather heavily any circuits to which it is connected. Short of using separate "audio" and "RF" leads with in-built isolating components, we would suggest reducing the input capacitor to the OA80 from .005 mfd to nearer .0005 mfd.

A piece of low-capacitance coaxial cable should be used for the "Y" lead, twin plastic flex serving for the "X" leads.

Our correspondent claims that the non-critical nature of the circuitry makes it ideal for anyone wishing to use components from the spare-parts box.

6V DRIVES FLUORESCENT TUBE

Mr. S. E. Cheeseman of 227 Korrongulla Crescent, Primbee, N.S.W., describes how he operates a 40 watt fluorescent tube from a 6 volt car battery. While admitting that the scheme has some limitations, Mr Cheeseman suggests that it might form the basis for further experiment.

ASIS of the scheme is an old Ford spark coil, though other discarded ition coils may be tried. The primary connected to the battery and the high tage secondary leads taken direct to terminals at opposite ends of the e.

Due to the poor regulation of these ices the voltage will drop sharply e the tube fires, but the high voltage initially available fires the tube instantly, without waiting for it to "warm up." For the same reason, no current limiting device is necessary to protect the tube.

Mr Cheeseman points out that the light is not as bright as when the tube is operated in the normal way, but claims that it is still quite useful. Other readers may care to try a similar experiment.

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Let's Buy An Argument

"They say it's dangerous to sit too close to a television set." This famous "they say" was recited to me many times while in hospital, although I was never quite able to discover exactly who "they" were, or the precise nature of the danger in question.

by Neville Williams

I MUST confess to being a trifle touchy about any statement beginning with "they say."

"They say" you know "that you should never drink from still water, but running water is O.K."

Whereupon people on picnics refuse to dip from an accessible pool but clamber 20ft over rocks to dip the same water where it happens to be visibly in motion.

NOT ALWAYS VALID

The old saying does apply, of course, in certain restricted circumstances but there are equally many other cases where its application is just plain nonsense.

Again, there is a definite relationship between the colour of exterior surfaces and their ability to absorb or radiate heat. But I imagine that one would have a hard time proving what "they" often say — "that red flannel undershirts are warmer than those of any other colour."

So it was that I "discovered" the danger of sitting too close to a television set, when I hired one to help while away the long evenings in hospital. Because I wanted to be able to reach the controls and to operate with low sound volume, I hired a 17in table model, which could perch atop the bedside cupboard.

By leaning over one way, I could reach the controls; by leaning the other, I could get far enough away to avoid visual discomfort.

It is a fact, of course, that visual comfort should be studied when watching television, if only because one is likely to watch it for quite lengthy periods.

We had a lot of argument and discussion about this problem a few years back and there's no point in going over it all again just here.

In brief, however, one should not vie television from a distance — either t great or too small — or under conc tions of ambient light or of pictu brightness, which are likely to cau visual strain.

But there are no precise or univers rules about such things for the simp reason that people differ so widely their visual aberrations and sensitiviti and in their degree of concentration the image.

However, many people do find it di comforting to view too large a pictu from too close up and from this h evolved a few broad "rules" about pi ture size, optimum viewing distance ar various other factors.

NO EFFECT

In my own case, I suffered no appa ent reaction from viewing the 17in scree from fairly close up — at least for th length of time I spent watching it.

Futhermore, as an alternative, found that I could watch the picture v a good quality shaving mirror on th opposite side of the bed. This markedl increased the viewing distance, thoug it took a little while to get used to a the back-to-front adverts and the lef handed gunmen!

It seemed, however, that over an above visual problems, many were appr hensive about X-rays. They had hear that television sets produce X-rays and if you sit too close to them, you ar likely to become "kind've radio-activ or something."

This is quite an old one, of course but it appears to have been regenerate by all the recent talk about radio-activity and the possibility of excessive exposure to harmful rays.

In itself, this discussion is all to th good for it is focusing attention on many pertinent questions.

IMPORTANT QUESTIONS

How much radiation can the human body stand without showing apreciable reaction?

What is the relationship between possible radiation limits and age, sex, genetics, etc.?

Are radiation effects accumulative or otherwise?

Should there exist some system for recording X-ray or other radiation exposurees for each individual?

That thoughtlessness exists was evidenced by an incident some time ago volving yours truly. Apparently a par-cular X-ray machine had been ex-biting an intermittent fault so the diographer cycled it three times to eck it, before exposing the plate — th the business end pointed squarely my midriff!

As far as the operator was concerned, was purely an apparatus problem, th no concern whatever about the pos-le undesirability of quadrupling the tient's X-ray exposure.

But getting back to television, I have t been able to find any real support, om authoritative sources, for the idea at ordinary television receivers radiate rmful X-rays.

ERY SOFT RAYS

There seems to be common agreement at ,at the usual EHT voltages of 14 to KV, only very "soft" rays will be nerated — that is rays with extremely v powers of penetration.

This being the case, they will be bstantially absorbed by practically any ysical materials between the emissive urce and the possible recipient. This cludes any glass work, metal shielding, e wooden cabinet, the clothes which e recipient may be wearing and even e atmosphere.

One series of measurements, which I ad about, indicated that the only region which X-rays could be detected at with sensitive instruments was in the mediate vicinity of the EHT rectifier and then only with the protective ield removed.

It was suggested that a person would ve to expose themselves deliberately the unshielded rectifier — very close and for a very long period — to ual even the dosage commonly em-oyed for medical purposes.

Only with very large screen receivers, colour receivers employing a much gher EHT supply voltage would the oduction of X-rays have to be con-lered as a design hazard.

This at least is the position as it pears at this moment.

In the light of all this, I couldn't avoid raised eyebrow or two when I read an ticle on the subject recently in a local agazine.

A large picture at the top of the page rries the caption "These American ildren are sitting too near that set ."

OT A MONSTER

Was it a colour receiver or one with monster screen? Oh no. As far as could judge, it was a very ordinary in table model and just about as in-cuous as a domestic receiver could be pected to be.

Having seen the bold heading and id such a caption, the reader could rdly be blamed for retaining an exag-ated impression or for observing to friends at some future date:—

"They say, you know, that you should t sit too close to your television set. produces X-rays!"

Equally intriguing were the paragraphs the article, in heavy type, correlating supposed X-ray hazard with cheap s or do-it-yourself repairs.

The reader was warned against:—

- Home-made or below standard re-vers.
- Receivers long overdue for service.
- Interchanging or shifting wires.
- Replacing vital parts himself.

I'm afraid these bold words of advice don't check with the facts as I understand them.

Television receivers, expensive or cheap, home-made or otherwise, normally use plenty of shielding around the EHT circuit, partly for physical protection and partly to confine interfering signals which may be radiated therefrom.

And I have yet to see a television chassis offered for sale with the intention that it should be operated without some sort of a cabinet, which should offer further incidental protection.

In other words, I can't see much connection between the price or origin of a television set and its potential as a generator of X-rays.

LESS EHT

A further point is that the EHT circuity of the average television set is dependant on fairly critical peaking. If it is upset in any way, by far the most likely result will be a loss of EHT voltage.

The set owner who decides to "stick this little wire over here" or changes "this do-da to fit more snugly next to that do-da" (I am quoting the original text) is therefore much more likely to end up with a duller picture — and even less X-rays — than with the reverse situation.

And what of the old set, which has not been serviced for years? In my book the aging components and tired valves would be doing well to produce enough EHT for a picture. I see no reason at all for expecting the EHT voltage and X-ray output to rise.

Just the reverse, in fact!

CLASSIC STATEMENT

Last but not least comes the classic piece of advice not to tape up all the perforated ventilation openings in the back of the set. I quote:—

"When this is done, the X-rays haven't anywhere to go but forward and the ones that filter through the front are definitely too powerful for safety."

It will surely come as a surprise to all concerned that, whereas steel and woodwork absorb X-rays, adhesive tape is able to reflect them clear out again through the front of the set!

Mind if I say "hooey?"

It is perfectly true that you shouldn't block up ventilation holes.

Let me whisper the reason. It stops the ventilation and may cause the internal works to overheat.

In saying all this I do not for one moment discount vigilance in respect to radio-active rays in any form, whether from the humble television set, or medical X-ray equipment or the hydrogen-bomb. But please let it be based on authoritative data.

In any case, we will watch with interest what comes from the Third Aus-

FROM THE "PIRATE" WHO TELLS

Dear Sir,

I thought this item may interest you and your followers.

You probably read about an illegal radio station being "removed" from the breeze on August 4. Well, it was my station they threw the axe at.

I have been broadcasting on 14.98 megacycles now for four years. No doubt some of you have listened to my programs. I had sessions in English, Greek, Italian, German and Scottish.

The transmitter consisted of a 40-watt final (6AQ5's in push-pull), two 6AQ5's as buffer amplifiers and a 6AQ5 crystal oscillator.

My modulator was a 17-watt, R. TV and H. ultralinear amplifier, modified to EL34's in the output and working into a 600-ohm secondary on the modulation transformer.

The P.M.G. said that my quality both on recording and on speech was better than the majority of broadcast stations.

The studio equipment consisted of two Garrad 4HF transcription turntables, four Zephyr 30RD studio microphones, a Byer 66 tape deck and my own fader and mixing panels on the consoles.

I had two studios and a 10-watt standby transmitter. I was using a Pi-coupled ground-plane mast approximately fifty feet high.

As you can see, I had a really professional set-up.

The program times: 5 a.m. breakfast session; 6 a.m. news; 6.10 a.m. Hit Parade; 6.45 a.m. Breakfast session; 8 a.m. Requests.

By the way, I had requests from all over the world—America, Africa, Canada, New Guinea, New Zealand and I received a tape recording back from Middlesex in England. The quality was amazing.

Back to the programs: 9 a.m. National Anthem; close. 5 p.m. Hit Parade (Australian); 5.30 Greek program; 6.30 p.m. Italian Hour; 7.30 p.m. &c all nationalities.

I had announcers, by the way for all Continental programs. The Greek girl was on the BBC up until 1947. I am an announcer myself, as well as being a radio and TV technician.

It took me about two months to build the station and I had a lot of satisfaction out of it.

But to anyone thinking of doing the same—DON'T! It's not worth it. I now have no station and I was fined into the bargain. So I don't think it is a paying proposition to open an illegal station just for the fun of it.

Well I hope you can get something of value from this very quick letter. I would like you to publish this as I think a lot of people would be interested.

By the way, I am a keen reader of "The Serviceman Who Tells!" Wonderful sense of humour.

Keep up the good work.

(Signed) G. Wright,
("The Voice of the Past")

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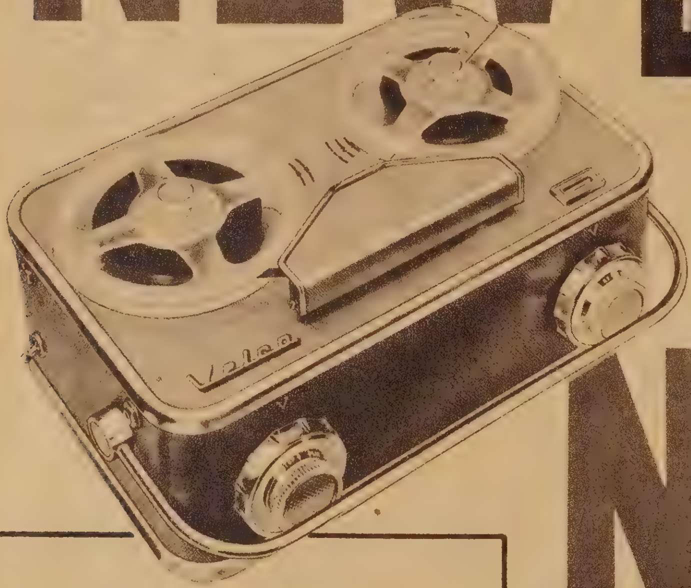

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- Self-adjusting Servo differential brakes.
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- Models TR 7 and TR 7R optional single or twin track leads. Stereo models four tracks.
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- Dimensions — 13½" x 8½" x 4½" deep.
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- Push button spooling operation can be operated in either flat or upright position.
- Will accommodate 3", 5" or 7" spools.
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- Permanently lubricated. No oiling required.

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ılian Conference on Radiobiology. ıis is currently being held, as I write, the Sydney University.

To change the subject, you may have ticed some remarks in the editorial ıt month, on page one, on the subject illegal radio transmissions. These ːre based on the newspaper reports d on my own opinions formed through e years.

It so happened that, while the issue ıs printing, we received the letter re- oduced elsewhere over the signa- re of G. Wright. As you will observe, gives the personal viewpoint of one of e offenders convicted of originating ese illegal transmissions.

EEN

It indicates a man who is tremendous- keen on electronics, coupled with self- pression in the entertainment field; so en, in fact, that he has obviously been ɪ to outlay a great deal of time and oney on something he must have known uld not last.

Now the axe has fallen; the station is more and the accompanying fine has ft a further hole in its promoter's bank count.

Whatever else one might deduce from the letter, I trust that this simple fact will get through. "Pirate" transmissions are bad in principle and, if you are caught, they can cost you plenty!

In saying this, I am not speaking as ıe who has never suffered the tempta- on.

Coming into the city as a young man, was so keen to work on receivers that even resented the meal breaks. In ct, I still do, on occasions, when in- lved in an interesting project.

In due course I began to dream about erating my own transmitter, thinking a dozen "good" reasons why I could nore the need for a licence; why I ouldn't get caught.

But a fellow enthusiast, to whom I nfided my plans one day, seemed angely unenthusiastic. I found out later at he was the then secretary of the ireless Institute of Australia!

Later I saw the wisdom of the regula- ons and of devoting the necessary few ıonths to prepare for the A.O.C.P. xamination.

My chief regret, at the moment, is the ck of time which prevents VK2XV om being heard much on the air.

VEN EASIER

Nowadays, aspirants can even skip the orse Code test and qualify for opera- on on VHF by passing in theory and gulations only. And, if you have any oubts about the rewards of VHF opera- on, ask any amateur who is active on ese bands.

But perhaps you feel that you simply ıust fiddle around with microphones, rntables, feeders and all the other araphernalia of the audiophile. May I ake a suggestion.

In every district there are churches, dges, welfare groups, dramatic socie- es, etc., who have a desperate need r someone to take an interest in their ıdio problems. They can offer an out- t for all the knowledge and enthusiasm ou can muster — without the constant ar of broken regulations.

Think it over!

By way of conclusion, here are a ouple of small argumentative ques- ons:—

BRITISH BLOWLAMP IS NOT NEW

I noticed in an old copy of your periodical "Radio and Hobbies" (December 1959) a "new" British-made blowlamp is described.

I would like to point out that this British so-called "new blowlamp" is DEFINITELY not new. There is plenty of evidence that the lamp appeared on the European hardware market in the years 1926-1928.

It was made in Germany, was made out of brass and was designed in two types: (a) for petrol, (b) for methylated spirit. Its name was similar to "Optimus" or "Primus."

The picture of a similar lamp is enclosed here. I personally have used the lamp for indoor and outdoor work in connection with installation of radio aerials.

I considered the lamp as so good that in September 1959 I wrote to some of my acquaintances to get and send me one, if they still were available on the market. At the same time, purely by memory, I reconstructed the lamp and have it at present in my possession. The reconstruction has some faults, but I hope soon to obtain the original lamp from Germany.

If you consider that these facts are not sufficient proof, please ask the technical-minded migrants from Europe do they remember the German spirit-blowlamp. You will find that this British "invention" is merely a modified COPY of an already known German instrument.

Yours faithfully,
W. Peterson.

In many TV receiver circuits, including some published in your magazine, it would appear that a positive voltage is being applied to the controlled grids via the AGC line. Is this correct?

This is a case where appearances can be deceptive. To be sure, it is often possible to trace a DC path from a high-tension point to the AGC line, the path usually involving two or more resistors of relatively large value.

However, somewhere along the line, you will normally find a valve with its cathode at or near earth potential and this changes the picture quite a deal.

"KEYED" OPERATION

This valve is "keyed" or made to pass heavy pulses of current by the application of sync. pulses to its grid and simultaneous line-scan pulses to its plate, the latter through a capacitor.

The charge which is developed across this capacitor by the pulses is opposite in sign and greater in magnitude than that which is fed to it via the resistor from the high tension line.

In consequence, the average potential at the plate, as measured on a VTVM is negative, not positive. Duly filtered to remove the line pulse information, this average negative potential is applied to the grids as the AGC voltage.

When the receiver is not tuned to a station, the pulsed energy may not be sufficient to overcome that from the HT line, with the result that a positive-going potential would be fed to the controlled grids.

To take care of this, designers often wire a diode between the AGC line and chassis, so that it prevents the AGC line from going positive, though not limiting any negative excursion.

When used for this function the diode is described as an AGC "clamp."

In many cases, the inclusion of a clamp diode is little more than a technical nicety. The grids of the controlled valves perform their own "clamping" action by drawing current whenever they are subjected to a positive voltage.

Provided the positive voltage is applied through a large resistor, the small grid current which can flow cannot harm the valves.

Why is greater use not made of the suppressor grid in a pentode? Could it not be connected to a positive potential or fed with signal?

The main role of the suppressor grid in a pentode is to discourage the secondary emission of electrons from the plate to the screen grid.

With this in view, the suppressor is normally designed so that, when it is returned to cathode or near-cathode potential, its field repels secondary electrons back towards the plate without, however, greatly affecting the normal cathode-plate electron flow.

Therefore, the suppressor grid is serving a very useful purpose, even when it is simply connected to cathode or earth.

AVC APPLICATION

Occasionally the suppressor is made to serve a supplementary function. AVC has been applied to it, to supplement AVC action of the control grid; it has also been used as a signal injector grid for audio mixing and frequency conversion.

However, to serve its primary function, the suppressor is necessarily of open structure and well separated from the cathode. Therefore its sensitivity as a control or signal electrode is comparatively low.

Returning the suppressor to a positive potential would have an undesirable effect, in most cases, since it would begin to collect secondary electrons from the plate and defeat the very purpose of its inclusion.

OFF THE RECORD — NEWS & REVIEWS

A recent artice in "The Gramophone" reminds us that it is now ten years since microgroove records made their first impact on the domestic market. Within that relatively short space of time, they have transformed listening habits, ousted the older standard and paved the way for stereo.

by Neville Williams

THE introduction of microgroove records was, very largely, the outcome of a demand for a recording medium which would offer longer playing time, improved fidelity and reduced bulk. The traditional 78 r.p.m. shellac disc—a heritage of the days of mechanical reproduction—was sadly lacking in all three respects.

Playing from only three to five minutes per side, several discs were required for a single major work, with the attendant necessity of numerous and undesirable breaks in the music.

Quality was mediocre, noise level high and the bulk and weight of the records was a familiar problem to anyone with a substantial collection.

In fact, compared with what has been achieved since, in all three respects, the old 78's were notably and inescapably inefficient.

MEMORABLE OCCASION

I shall never forget the first demonstration in Sydney of 10 and 12-inch LP's. I doubt that there was a single person present who was not literally staggered by the quality of reproduction, even on simple gear, by the lack of background noise and by the greatly extended playing time.

Nor did they miss the nonchalant way in which the demonstrator flung the record across the room, like a flying saucer, to emphasise its light weight and the fact that it was indeed "unbreakable."

Not everyone admitted to being impressed, however. While some saw the inevitability of the new standard, particularly for major works, there were many others who were ready to talk them down.

The new disc cut right across established industry associations and marketing methods. For some of those present, it would not have been politic to show enthusiasm.

COMPATIBILITY PROBLEM

Others simply could not envisage the public being prepared to scrap their time-honoured playing equipment to put in new motors and pickups. They were apprehensive about the durability of fine styli and the ease with which the closely packed grooves might be damaged.

In fact, none of these problems, or others not mentioned, have proved insuperable. The readiness with which manufacturers solved—and the public accepted—3-speed motors and turnover pickups is a matter of history.

So also is the mass production of sapphire and diamond styli and the evolution of pickups which inflicted relatively far less damage on grooves than did their older counterparts.

Nowadays, microgroove records are used by the whole family, as a matter of course, and record wear receives scarcely a mention, despite a half-dozen good reasons why it might have been otherwise.

We are, in fact facing a period when 78 r.p.m. playing facilities may well be dropped from much new equipment. Where they are retained it will be due as much as anything to the fact that they can be included without any great complication or cost.

In a technical sense, microgroove records became possible as a result of work with the older standards in the immediate post-war period.

Decca made a determined effort to refine their recording techniques and to exploit treble pre-emphasis, which resulted in the release of the ffrr (full frequency range recordings).

E.M.I. were doing parallel work which made it possible for their then chairman, Sir Ernest Fisk, to demonstrate before the Sydney Division of the Institution of Radio Engineers, the successful recording and reproduction of 20,000 cps on a conventional disc.

PICKUP DESIGN

At the receiving end, much attention was being given to pickups, with a view to evolving non-professional types which could boast low mass and high compliance, together with reduced distortion and wider frequency response.

Some of the moving coil, moving iron and crystal types, which we saw as a result of these efforts, were pretty primitive by today's standards, but they showed the way.

They demonstrated that pickups did not have to be "built like battleships;" that frail moving systems could be protected against mishandling by suitable design; that reduced output was a price worth paying for improved fidelity.

No less important, I think, was the fact that the asociation of all these developments, with better amplifiers and speakers, awakened the industry to the fact that it could not forever serve the interests of compatibility; that enlightened amplifier enthusiasts should not be condemned to the same fare as a native in the Himalayas, possessed only of a mechanical phonograph.

Out of all this came the speculation about the feasibility of slower speeds, finer grooves, smaller styli, etc.—speculation which led the American Columbi Company to launch the first LP micrc groove in December, 1948.

It was probably before its time be cause, while it did achieve long-play, i carried a heritage of mediocre fidelit and difficulties in mass production. I was another two years before Decca, f England, were prepared to launch thei own LP's, confident that they coul claim long play, together with hig fidelity and consistency of production.

Meanwhile the battle of the speed had developed. There were many wh were prepared to say that 33 r.p.m. wa too slow; that 45 r.p.m. was a bette compromise and that the industry shoul standardise on the 7-inch 45 r.p.m. dis with a new type of rapid automati changer to preserve near-continuity fo long works.

BATTLE FOR 33

Such was the spirit of the controvers that many record companies deliberatel held off to see which way the proverbia cat would jump.

It is said that the battle for the 3 LP disc, as a medium for major work was won by a reviewer, who was invite to address the board of a large concer interested in promoting only the 4 r.p.m. standard.

He declared that the LP was prefe able because it did away with sid changes in the middle of an extende piece of music. The firm countered wit the fact that their new record change reduced the gap to an imperceptibl space of four seconds.

"Look," said the reviewer, "you're i love with another man's wife. Fo months you wait your chance and a last he leaves home. You seize you advantage and everything goes swim mingly, except that every four and half minutes the husband opens th door. But he only opens it for fo seconds. How do you feel?"

VICTORY !

Allegedly the board voted, to a ma to adopt 33 r.p.m. for long playin works and the reviewer was later give a place on the board for his perceptio

With the uncertainty removed an rendered trivial by the evolution c simple 3-speed players, the world's re maining record companies began to g into the act, with the big E.M.I. co cern publishing their initial 51 discs i October, 1952.

In the train of the LP came man problems and arguments: Levels v. pla ing time; frequency compensation cha acteristics; the need to re-record enti catalogues to the fidelity standards whi buyers had come to expect; couplin desirable and otherwise; balance betwe soloist and orchestra; microphone tec niques; tape hum and hiss; falsificatio pitch; record surface plops, due to nishes and dust.

ut problems or no, the microgroove has worked wonders for the record istry and for music lovers generally. xpanded the catalogues enormously brought to light works that had ; been almost forgotten. It trebled size of the record industry, whereas e was danger of it shrinking.

n the words of one executive "it did music what printing did for litera-
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It, too, has its problems but it represents a further step towards the ultimate in sound reproduction—whatever that may be. Already the solution of its attendant problems has brought us better recording lathes, better pickups and better turntables.

Truly, a great deal has happened in 10 short years.

REVIEW OF SACRED RECORDINGS

"HYMNS FROM THE HEART" ung by Rosemary Clooney. Mono, IGM E3782.

Rosemary Clooney will be known to st readers as a singer of popular— l sometimes very animated—songs on :, film and television. Such, however, ier personality and apparent sincerity, t it is no surprise to encounter this sent collection of "Hymns From The art."

And the hymns are sung in just the y that the title suggests.

Backed variously by choir and instru- nts, the soloist uses a very close crophone technique, which sounds newhat unfamiliar, for this kind of isic, for the first few grooves. But e soon grows accustomed to it and ention focuses rather on the superb tion and voice control which Rose- ry Clooney exhibits.

She sings 14 hymns in all, everyone ll known and ranging from the tradi- nal "Rock of Ages" through "The tle Brown Church in the Vale" to e modern "It Is No Secret."

Quality of reproduction throughout is cellent and the noise level is virtually ro.

If you are on the lookout for a col- tion of hymns, sung in an intimate, ntemplative fashion, I can thoroughly commend this disc.

* * *

"SING A HYMN WITH ME," presented by Tennesse Ernie Ford. Mono, Capitol T1332.

Here is another disc which would rep- sent a good family investment.

Tennesse Ernie Ford is one of the bet- known singers of gospel hymns. Here departs from his conventional role as "straight" soloist and seeks to build e atmosphere of a revivalist praise rvice.

He introduces each number as a solo, en breaks in to invite all and sundry sing with him. Whether individual teners do so or not is of secondary portance, because a choir accepts the vitation.

In all, it is a happy, rollicking, but t irreverent collection of gospel songs. According to the jacket all the hymns e taken from "Singin' Billy" Walker's OUTHERN HARMONY songbook, e that is unknown to me personally. it not so the hymns; there are 14 of em, all of the Sankey/Alexander vari- y.

Quality is excellent and surface noise rtually inaudible. An excellent record if you like the community singing kind of atmosphere.

* * *

"CHORAL PRAISES" by the Baylor University Chapel Choir, directed by Dr Euell Porter. Mono, GFM (Gospel Film Ministry) 32-W3049-LP.

This record will have its main appeal to those with a prime interest in light choral music.

The choir is one of 70 voices, male and female, singing, for the most part, without instrumental accompaniment.

The program on this disc includes several hymns, the song "Holy City," "Four Pslams" by Schultz and a choral composition "I Am Music."

All are sung in a restrained, well disciplined fashion, with diction as good as it can be from massed voices.

Technically my main criticism of the disc is an apparent tape hum, which is evident behind all the selections but not between them. It was noticeable, though not distressingly so, on my fully baffled speakers. With less elaborate gear, it would probably not be heard.

"TAKE GOD ALONG" by the Camp-of-the-Woods Band, conducted by William N. Stanley, with Edward Lyman, tenor. GFM (Gospel Film Ministry) 30-W3066-LP.

According to the notes on the jacket, Camp-of-the-Woods is a holiday retreat in the "beautiful Adirondack Mountains in New York State." It is staffed and patronised mainly by young people, of High school and college age, from whose number the band is made up.

I can well imagine that the band would be a huge success with the intended audience, aided by spectacle and the woodland setting. As straight audio it is less successful.

The variations on hymn themes are ambitious enough but don't always come off.

Ewdard Lyman has a powerful operatic tenor voice but, again, his association with the band is not an entirely happy one.

I imagine that the record's greatest appeal will be to anyone interested in instrumental hymn variations, with an eye to style rather than detail.

* * *

"RESPLENDENT THEMES." Hymn tunes scored for symphonic strings and conducted by Paul Mickelson. GFM (Gospel Film Ministry) 28-W-7002-LP.

This is yet another record built up on variations of popular hymn tunes. In this case, however, the players are fully equal to the task and the dozen familiar hymn tunes are developed into themes which I think most of the intended audience will find attractive.

Paul Mickelson has sought for—and achieved—the familiar atmosphere of "singing strings" supported, as necessary, by harp and other solo instruments.

The recording quality is excellent,

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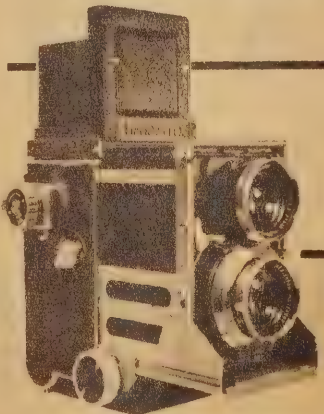

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quency response adequate and noise el low.

In fact, this would be a good record have available, as bridge and back- ound music, for dramatic or slide pres- tation of the religious variety.

IN VARIED MOOD

"STEREO SHOWCASE." Twelve popular selections, with 12-page brochure included. Stereo, Capitol SKAO1268.

You can please yourself whether you gard "Stereo Showcase" as a demon- ration record or a collection of a dozen ell-played and well-recorded popular lections. Either way, it would be a orthwhile addition to a popular col- ction.

Included are contributions from Billy lay, Les Baxter, Joe "Fingers" Carr, elson Riddle, Ray Anthony, Red icholls, The Mighty Accordion Band, ack Marshall, Webley Edwards, Les rown, Jackie Davis and Felix Slatkin.

Great care has obviously been taken ith the preparation and recording of ach individual item, and the disposition f instruments is explained in the bro- hure which comes as part of the album.

The recording quality is particularly lean and the balance excellent, while nere is enough of stereo spread and ereo gimmickry to keep everyone appy.

And the noise level is low — at nor- nal listening levels! I add this remark ecause, with a record like this, there a strong temptation to "turn up the ick" for the fun of it, saturating the oom with sound but leaving the record oise similarly boosted between selec- ion.

A showcase indeed!

★ ★ ★

"NELSON EDDY FAVOURITES," with Nathaniel Shilkret and Orchestra. Mono. Camden CAM-26.

Strictly for nostalgia is this budget- riced LP. Dubbed from recordings made n the 1935-37 era, it contains the music hat Nelson Eddy helped to make so opular at the time.

The titles are as follow: "Ah, Sweet Mystery Of Life," "Love's Old Sweet ong," "A Dream," "Trees," "The Hills f Home," "Tramp, Tramp, Tramp," The Rosary," "Oh, Promise Me," "When Grow Too Old To Dream," "Auf Wei- lersehen" and "Oh, Perfect Day."

As might be expected from dubbings, he frequency response is limited in the pper register and the voice has a slightly metallic" edge, which presumably re- ults from the use of a filter in the re- ecording chain. However, the same iltering has virtually eliminated back- round crackle, so that the disc is com- nendably quiet.

Fans of the Nelson Eddy era should njoy it.

★ ★ ★

"IN A MONASTERY GARDEN." The Immortal Works of Albert W. Ketelby, played by the New Symphony Orchestra of London, conducted by Robert Sharples. Mono, Decca LK4329.

On sighting this disc, I was reminded of an earlier "Immortal Works" of Ketelby also released by Decca but played by the New Symphony Orchestra under Stanford Robinson.

The contents of the two discs are much the same, the present line-up being as follows: "In A Monastry Garden," "Wedgwood Blue," "In A Chinese Temple Garden," "The Sanctuary Of The Heart," "'Appy 'Ampstead," "In a Persian Market," "The Phantom Melody," "Bells Across the Meadows," "In The Mystic Land Of Egypt."

The treatment and balance also shows minor variations. Sharples' treatment is somewhat more "outspoken," the bass end is lighter for the same control settings but the trebles are cleaner. This last is only to be expected of a later recording, although the earlier pressing may have lost something, in the meantime, by reason of repeated playings.

If you already have the earlier recording, you probably wouldn't want to "duplicate" it with the newer one. On the other hand, if you're on the lookout for some of Ketelby's tuneful selections, the new disc is safe buying.

★ ★ ★

"AFTERGLOW." Love Songs By June Hutton, with Axel Stordahl. Mono, World Record Club XE1113.

The smooth, crooning voice of June Hutton is always centre stage in this record but she receives plenty of support, nevertheless, from the orchestra under Axel Stordahl. His accompaniment, sometimes lyrical, sometimes bouncy makes free use of massed violins.

By way of variety "The Boys Next Door" provide vocal background but so restrained that they blend, for the most part, into the general instrumental pattern.

The theme throughout is love, with songs such as "Until The Real Thing Comes Along," "It's The Talk Of The Town," and "East Of The Sun."

The recording quality throughout is consistently good with just here and there, a trace of tape-hiss — but not enough to worry about.

★ ★ ★

"GOLDEN AGE OF THE DANCE BANDS" played by the New World Dance Orchestra. Stereo, WG—BMM—868.

The New World Dance Orchestra has been made up from members of famous dance bands of a past era.

The music they play is a note-by-note copy of arrangements made famous by those bands. To be precise, this is a re-creation of the music of Glen Miller, Tommy Dorsey, Harry James, Benny Goodman, Artie Shaw and Jimmy Dorsey.

Among the dozen titles are "You Made Me Love You," "In the Mood," "Amapola," "Jersey Bounce" and "Stardust."

Technically, the sound is first rate, clean, noise-free and with excellent stereo distribution. Plenty of spread but no hole-in-the-middle here.

★ ★ ★

"ONE STEP BEYOND," Music from the television feature played by the Berliner Symphoniker Orchestra, composed and conducted by Harry Lubin.

As indicated by the title, the numbers on this disc were devised as background music for the television series "One Step Beyond" — a deliberately "spooky" venture into the realms of psychic phenomena.

However, if you are tempted to buy the record for playing to children just before bedtime, you are likely to be disappointed.

The first selection "Fear" is spooky enough, compounded as it is from electronic instruments and soprano voice. The last selection "Jungle Aire" may also be successful as a prompter of nightmares, with its sense of impending something-or-other.

But the nine titles in between, while they might have fitted the television picture, lose their sinister character when they are separated from it. In fact, they become rather tuneful mood music.

The disc is technically good, throughout.

★ ★ ★

GORDON MACRAE, "Songs For An Evening At Home" with orchestra conducted by Van Alexander. Stereo, Capitol ST 1251.

Gordon Macrae, with his pleasant, easy voice, sings his way through a dozen or more old-time songs, including such numbers as "Always," "The Bells Of St. Mary's," "Let Me Call You Sweetheart" and "Trees."

He is backed in equally pleasant fashion by an orchestra under Van Alexander, which takes time off, in between, to play an improvisation on "Three Blind Mice."

The record is built around the gimmick of an actual evening at the Macrae home, with doorbells, greetings, a father-daughter duet and farewells at the end. Whether the record gains by this treatment is debatable. I doubt it.

The general standard of reproduction I would rate as merely adequate. It is clean enough and quiet enough most of the time but some of the volume peaks seem to stop just short of disaster.

However, while not a technical showpiece, it is pleasant enough listening.

★ ★ ★

RUSS CONWAY, "Family Favourites," piano with accompaniment directed by Geoff Love. Stereo, Columbia SCXO 3272.

Russ Conway presents no less than 18 "oldtimers" on his semi-honky-tonk piano, backed all the way through with a modest rhythm accompaniment.

As might be expected, the playing is concise and the tempo well maintained but I doubt that many would want to play too frequently through both sides at the one sitting. It is much more likely that the numbers will be played in small groups to suit the mood.

Among the titles you'll find: "With A Song In My Heart," "Anniversary Song," "This Is My Lovely Day," "Love Is Here To Stay" and "We'll Meet Again."

Technically, the disc is of routine quality, generally clean and quiet but with just a suggestion of tracing troubles on peaks on the inner grooves. Again, pleasant enough listening but not a technical showpiece.

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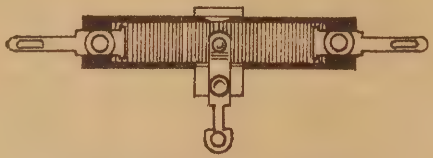

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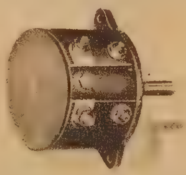

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IN REVIEW—By JULIAN RUSSELL

WO EXCELLENT CLUB RELEASES

Brahms — Piano Concerto No. in B Flat. Op. 83. Played by Louis entner with the Philharmonia rchestra conducted by Sir Adrian oult. World Record Club stereo. E218.

his is an excellent buy in the low- e field. The stereo is well-spread and solo instrument nicely balanced be- en the two speakers. Kentner main- s the solidity of the work while im- ıg it with more than its usual share fervour. To achieve this he is some- es a little wilful in his choice of pos paying scant respect to tradition and the composer's markings.

ut I found the result consistently en- able despite treatment of the Scherzo t robs it of some of its scherzando od. Purists may take exception to at they consider excessive use of ato in the Finale, but there is no stioning the forward progress of the stretto that brings the piece to an iting end.

A couple of inaccuracies have surpris- ly been allowed to remain uncorrected d a trifle more bite in the cello's tone ring the famous solo in the slow move- nt would have been welcome. A picion of prickle can be detected on surface during quiet moments. But se faults can easily be ignored in view the general high quality of the econ- ically-priced product.

* * *

Tchaikowsky — Suite from Swan Lake Ballet. Played by The Sinfonia of London conducted by John Hollingsworth. World Record Club stereo. TT19.

This, too, can compete successfully th higher-priced versions of the same ork. The brass is particularly well ayed and recorded and the woodwind ters and releases with knife-edged pre- sion. The string tone, however, could ve been a trifle richer.

The selection includes all the popular ems and a few lesser-known excerpts. ccasionally Hollingsworth's rhythms e slightly stiff-jointed, especially the ree-four in the first two waltzes, though e third is graceful enough to satisfy the ost critical listeners. And the lavishly nployed percussion though always aud- le never intrudes with vulgar insistence.

Some of the faster numbers have a ost attractive bounce, and the more omantic passages emerge elegantly hrased and warmly inflected. In this, o, a slight prickle now and again mars n otherwise good surface. The sound a little dry, is always beautifully clear.

* * *

Brahms — Piano Concerto No. 1 in D Minor, Op. 15. Played by Rudolf Serkin and the Cleveland Orchestra conducted by George Szell. Coronet mono. KLC2693.

It is a pity that such an affectionate performance as the soloist's was not rewarded by better engineering. His tone oscillates between light tinkling treble and metallic bass.

The orchestral tone, too, is not reproduced with Coronet's usual fidelity though its shortcomings do not hide the sympathetic nature of Szell's accompaniment. In its favour can be pointed out that the balance between piano and orchestra is always stable and that much lovely playing comes from all concerned. A stereo version, should one be issued, might correct some of the engineering weaknesses of this mono.

* * *

Tchaikowsky — Symphony No. 4 in F Minor. Played by the Boston Symphony Orchestra conducted by Pierre Monteux. RCA stereo SL16236. Mono L16236.

Pierre Monteux

The sound is superbly spacious and rich in the stereo version and fine, too, in the mono. But the difference is marked enough to encourage anyone who compares them to invest in two-channel equipment immediately. Among the great living conductors, Monteux and Beecham seem to have solved the secret of eternal youth. Beecham is 80 and Monteux is pushing it close. But both retain a sprightliness that might well be envied by leading conductors 30 years younger.

In this performance Monteux asserts his vitality by pressing his tempos to the limit — and perhaps to some minds, a little beyond. But his rhythms remain astonishingly full of life and his knife-edged precision of attack and release are a continuing joy to hear. His reading is fervent though never perfervid and if some of the climate of the Sixth Symphony intrudes into the Fourth here, under Monteux it seems to belong — at least while you're listening to it.

The playing of the Boston suggests that Monteux makes more exacting demands on his players than their regular conductor, Charles Munch, though they never fail to respond to Munch in like manner in works that still hold interest for the latter.

Where Monteux' perennial youth is so evident is in his presentation of works he must have been playing for the best part of 60 years yet still approaches with all the interest of a first examination.

* * *

Copland — Billy the Kid; Rodeo. Played by Morton Gould and his Orchestra. RCA stereo SL16202.

This is another successful transfer to stereo of an impressive mono disc. The separation is rather wider than that found on most European stereos but it is never purely gimmicky. The dynamic range is wide but not unwieldy and Copland's sharply defined instrumentation is admirably suited to two-channel reproduction. A trace of pre-echo sometimes precedes a fortissimo entry.

Morton Gould's orchestra handles the rhythmic complexities of this essentially American music as only an American orchestra can. I'd hesitate to use the adjective genial about the score of Billy the Kid, but it fits its companion piece, Rodeo, perfectly. This is a cheerful confection, full of vigour and high spirits, with some of the items pointed in a way that keeps the listener's feet tapping in time to the music.

Billy the Kid includes the ballet suite and, as a separate item, the Billy the Kid Waltz.

Rodeo features Buckaroo Holiday, Corral Nocturne, Honky Tonk Interlude, Saturday Night Waltz and Hoe Down. As you can see, it's all as American as Bourbon whisky.

* * *

Copland — Appalachian Spring (Ballet for Martha); The Tender Land (Orchestral Suite from the Opera). Played by the Boston Symphony Orchestra conducted by Aaron Copland. RCA mono L16230.

Tender is not a word it would occur to me to use about most of Copland's music and I don't think it applies here, despite the title of the second piece. The music is cool and to me suggests more than a little use of midnight oil though its technical skill is of a high order. It would have been interesting to hear how Copland used voices in his original opera score.

Although Copland is accepted as an echt-American composer, many of his tunes suggest English rather than American origins. Their harmonic and rhyth-

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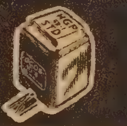

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c treatment however always remain aracteristically American. To me, Cop- d is a composer one can respect with- t affection, but it may have appeal to se who like their music stripped down its bare bones. The same might be d of the Ballet, Appalachian Spring.

* * *

Beethoven — String Quartets. No. 1 in F Major, No. 2 in G Major, No. 3 in D Major; No. 4 in C Minor, No. 5 in A Major, No. 6 in B Flat Major. All from Op. 18. Played by the Budapest Quartet. Coronet mono KLC2716/8.

Some three years ago a neck-and-neck e developed between the Hungarian ing Quartet and the Budapest in the oduction of the complete set of Beet- ven's string quartets. In some of them writer preferred one organisation, in ers the second. But on the whole Budapest's performances penetrated eper into the material than their rivals.

But the sound on the Hungarian's cs was, generally speaking, superior that on the Budapest's. That has w been remedied, for early this year Budapest re-recorded the present set America and the sound is now com- endably faithful, particularly if you ay these mono discs on stereo equip- ent. Faultless is not too strong a word use. Especially improved is the bal- ce between treble and bass with added nsparency in the inside voices.

The playing repeats the same idiosyn- asies as in the earlier set. Impeccable -ordination is sometimes — but only ry rarely — interrupted by some trif- g, unaccountable untidiness and the ader, after playing whole movements th impeccable intonation, now and ain gets a little off pitch.

But they still remain performances of tstanding merit and, as I wrote else- ere, seem unlikely to be eclipsed in foreseeable future.

* * *

Elgar — Enigma Variations, Op. 36; Purcell-arranged-Barbirolli — A Purcell Suite. Played by the Halle Orchestra conducted by Sir John Barbirolli. Pye mono PLC5020.

The sound in the Enigma is not Pye's st, nor is Barbirolli's performance de- ite much that is highly enjoyable. The eed at which he takes the stuttering le Dorabella number will surprise se who appreciate it played more acefully and affectionately. And the inifred Norbury variation displays ex- ssive speed, too.

But to balance them are enchanting adings of Ysobel and the richly ex- essive cello solo in No. 12. The mous Nimrod substitutes passion for garian nobilmente presentation, and finale is too hearty altogether. As ted above, this version of the Enigma s its good features but both Beecham's d Boult's are preferred by this listener. is surface of my pressing is not as an as it might be.

The surface is better on the reverse, rather dated "arrangement" of airs en from some of Purcell's dramatic rks — The Gordian Knot Untied, The rtuous Wife, King Arthur, and Dido d Aeneas. But the tunes themselves lovely and Barbirolli persuades his orchestra to play them with imaginative phrasing, and in the strings, delightful tone.

* * *

Milhaud — Le Carnaval D'Aix. Saint-Saens — Piano Concerto No. 4 in C Minor. Played by Grant Johannesen and the Philharmonia Orchestra conducted by Georges Tzipine. HMV mono CLP1149.

The Milhaud Suite should appeal to those able to enjoy the sensitive sophistication of the French school as it was manifested during the 1920s. There is not a serious bar in all this witty, lighthearted score, and soloist and orchestra manage it all with splendid aplomb. The items, some of them only a few bars long, have been assembled from a ballet called Salade, produced in Paris in 1924 and long since dropped from the repertoire.

The pieces are generally descriptive, some are parodies, others burlesques, and all mock gaily at pomposity in any of its forms. The dominating influences are Satie's and Ibert's, but the music is never imitative of their styles. If you're looking for an elegant trifle off the beaten track, I can recommend this disc enthusiastically, but the serious minded will not approve.

Maria Callas

The reverse may appeal more to them, though this, too, is chic rather than weighty. The Saint-Saens Concerto exhibits all that unenterprising composer's customary skill and contains tunes that you will hum after it is finished. And this, too, receives highly polished treatment from the artists presenting it.

Johannesen imposed beautifully delicate changes of timbre on his piano tone and keeps separate the notes of even the fastest runs and decorations.

* * *

Puccini—Manon Lescaut. Complete opera with Maria Callas (Manon), Giulio Fioravanti (Lescaut), Giuseppe di Stefano (des Grieux), Franco Calabrese (Geronte di Ravoir) and the Orchestra and Chorus of La Scala Opera House, Milan, conducted by Tullio Serafin. Columbia mono 33CX 1583/5.

This early work of Puccini has long been neglected in opera houses and has received only cursory attention from the recording companies. A pity, for it abounds in beautiful melodies, gives the

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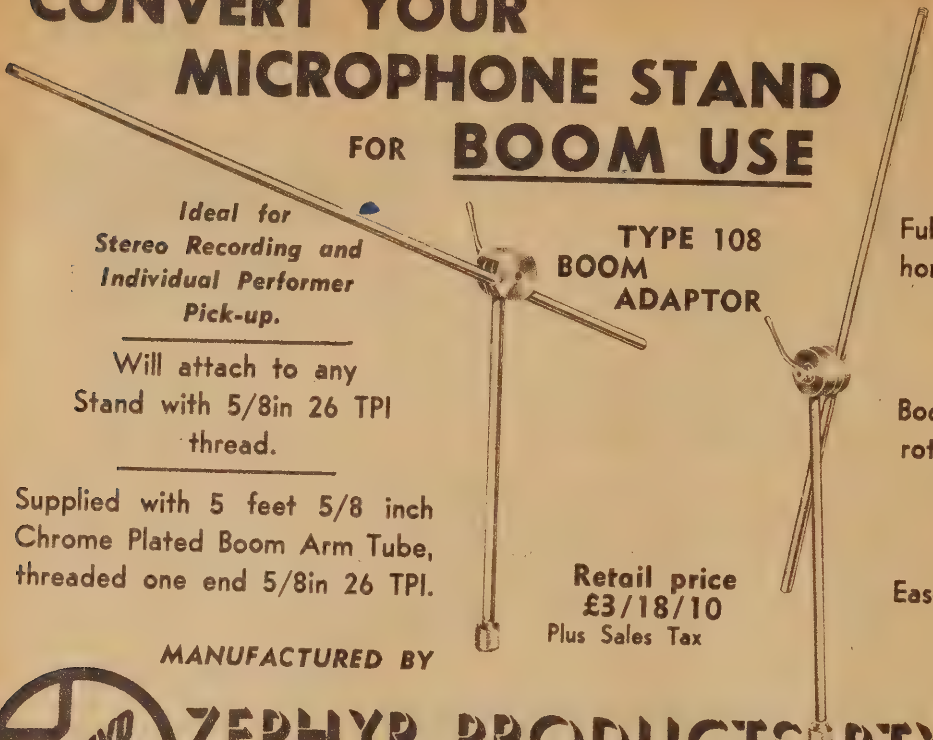

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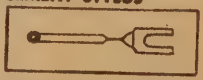

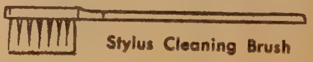

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rs plenty of opportunities to charac- their parts rather more realistically in many other operas, and has ents, if properly handled, of moving a.

e mono sound in this set is satis- ry but not of unusual merit, but it have to do since the company has lans for a two-channel issue. Much ame might be said of the perform- which is under the firm authority ullio Serafin who handles the Chor- nd Orchestra of Milan's La Scala a nice ear for balance and expres-

uch of the success of the produc- centres around Maria Callas' fine rmance of the title role. Her vocal atisation is, as usual, superb, and of her singing is in the same category. But she still tends to force top notes shrilly and places examples of careless intonation immediately after passages of exquisite beauty. She is probably one of the most irritating great dramatic sopranos of any age.

Di Stefano is placed too close to the mike during the early scenes but is better handled later, when his excellent musical manners expose some of Callas' inspired crudities but without removing him from the picture.

The other two major roles, sung by Fioravanti and Calabrese, are eminently pleasing, and the chorus, especially in the quieter ensembles, is both expressive and accurate. Some of Serafin's tempos may not appeal to those who prefer a little more sparkle in the music, but his is still a sterling performance, far ahead of his few competitors.

THER ITEMS — REVIEWS IN BRIEF

Beethoven—Sonata No. 9 for olin and Piano in A Major, Op. ("Kreutzer"); Sonata No. 5 for olin and Piano in F Major, Op. ("Spring"). Played by Henryk eryng and Artur Rubinstein. RCA ono L16234.

vo distinguished musicians working perfect co-ordination give impres- performances of these two popular tas. Their style may not always ad- to strict Beethoven "principles" but pieces provided me with constant ht in the skill and polish of the rmers and the immaculate "togeth- s."

* * *

Vivaldi—Concerto Grosso in D inor, Op. 3, No. 11; Mozart— renade in G Major (K. 525), Eine eine Nachtmusik, Bach—Prelude E Major. Played by the Musical ts Symphony conducted by Leon- l Sorkin. Concert-Disc stereo 31/12.

e first issues of this label were ed by freakish, gimmicky separation, that has all been adjusted in this rably spread and balanced disc. The rmances, too, are sincerely musical do not go out after cheap effects. sentimentalising occurs in the Vi- , and Bach's E Flat Prelude goes too to be as effective as it might. Most ssful is a gracious account of Eine e Nachtmusik, but, the Bach apart, est should please all but the most al stylist.

* * *

Organ Concert by Austin G. velace. J. S. Bach—Prelude and gue in A Minor; Wachet auf, ft Uns Die Stimme; Erbarm' ch Mein, O Herre Gott. Hermann hroeder—Schoenster Herr Jesu rom Organ Chorales, Op. 11); elude No. 6 (From Op. 9). Flor eters—Aria for Organ (Op. 51). uis Claude d'Aquin—Grand Jeu Duo. Concert-Disc stereo CS /18/.

e sound in this is also admirably and well spread both in width and . The playing is exceptionally well lated with the many changes of re- tion effortlessly audible. The or- t uses a first-class technique with minating musicianship. And some e pieces will probably be new even to enthusiastic performers on the unwieldy instrument.

* * *

Bach—The Majesty of the Luneburger Organ. Toccata and Fugue in D Minor. Toccata and Fugue in F Major. Toccata and Fugue in C Major. Played by Professor Michael Schneider. W and G stereo, WG-BMM-894.

This is recorded with such clarity that the mike might have been placed among the organ pipes, yet the music is commendably free from mechanical noises. The instrument is a huge baroque job built in 1551 by Heinrich Niehoff and said by the Luneburgers to have been Bach's favourite organ, though to whom Bach made the statement is not mentioned.

The whole disc is an outstanding example of modern virtuoso sound engineering in which perfect clarity is maintained throughout the most complex passages. Beautifully even voicing by Schneider, who gives a thoroughly musicianly and often exciting account of all three works.

* * *

Sorry, Wrong Number, by Lucille Fletcher (Agnes Moorehead). The Tell-tale Heart; Annabel Lee; Silence, by Edgar Allan Poe. Read by James Mason.

Agnes Moorehead gives a magnificent performance as the terrified woman who overhears on the phone a plot to murder someone and realises too late that she is to be the victim. She carries with great aplomb the burden of what is, except for a few minor interruptions, an immensely long monologue. The dramatic climax is splendidly managed.

James Mason occasionally overstresses the drama in the Poe pieces, though his voice is always pleasing to listen to. Best of them is the description of the fantastic landscape in Silence. The background music, composed and played by Buddy Cole on an organ, sounds like he was making it up as he went along.

* * *

Mozart—Piano Concerto No. 17 in G Major (K. 453). Piano Concerto No. 27 in B Flat Major (K. 595). Played by Alfred Brendel and the Orchestra of the Wiener Volksoper conducted by Paul Angerer. Vox mono APL 11260.

Chaste playing of faultless taste, if slightly undemonstrative, characterises both these performances. The balance between the pianist and his supporters is good, too. But the sound is much too resonant and hangs around long after it is due to disappear. This results in some lost detail in both the piano and orchestral parts, though admittedly a good deal remains. Had the sound been a trifle drier this disc could have been enthusiastically recommended to those who like their Mozart played with classic purity of line and a restricted dynamic range suitable to the period.

* * *

Beethoven—Wind Music. Octet in E Flat Major, Op. 103, for 2 oboes, 2 clarinets, 2 horns and 2 bassoons. Rondino in E Flat Major, Op. posth., for 2 oboes, 2 clarinets, 2 horns and 2 bassoons; March in F, No. 1; March in C, No. 2; March in F, No. 3. Sextet in E Flat Major, Op. 71, for 2 clarinets, 2 horns and 2 bassoons. Played by the London Baroque Ensemble conducted by Karl Haas.

Stylishly played and very faithfully recorded this disc will perhaps have a specialised appeal, but even those with a general interest in music should find much to beguile them in some of these charming pieces. I suggest they try the three saucy little marches composed for small combinations. Nothing of the philosophical Beethoven here, but plenty of fun and mock pomp.

(Continued on Page 111)

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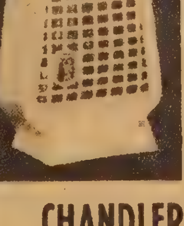

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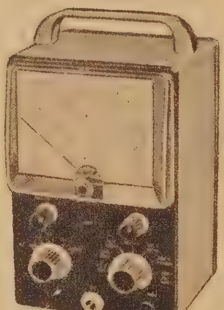

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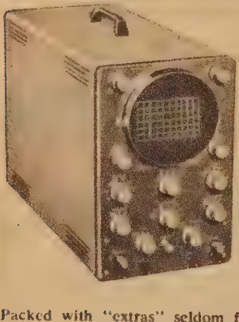

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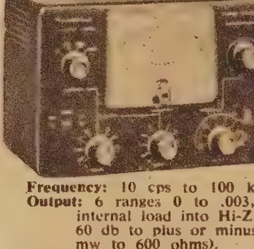

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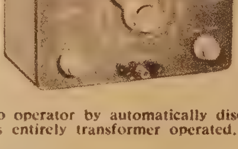

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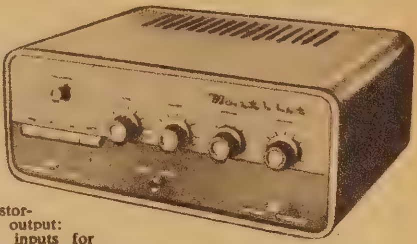

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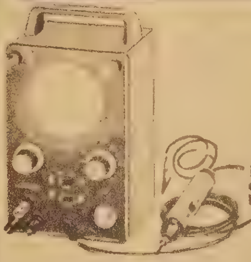

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As a wise precaution against obsolescence, pin connections are selected by individual lever type switches. Multiple pin connections present no difficulty with this system.

Sockets are provided for all valve types encountered in America, including sub-miniatures, and, as an added feature, stainless steel pin-straighteners are provided for seven and nine-pin types.

The Series String Filament Checker has a moulded case with gold and black anodised aluminium panel. It measures just over 5 x 3 x 1 in. Price £6/15/0, plus tax.

In addition to valves, the Model 10-60 also tests all current types of transistors, N-P-N, P-N-P, low, medium and high-powered. D.C. voltages are available for the purpose, in 22 steps and ranging between 0.5 and 160 volts.

Readings possible include Icbo, Beta, and emitter-to-collector leakage.

Here again, the lever switch system safeguards against possible variation in basing, while test settings for valves and transistors alike are presented in the roll-chart seen at the front of the tester.

A test data subscription service is available to registered owners of the equipment, being free for the first 12 months after purchase.

Pictured at the right is another very useful instrument in the "Precision" range, the model E-400 Sweep Signal Generator. Again very modern in design, it is intended for FM and TV testing, the latter on all current channels.

Employing a combination of fundamentals and harmonics, the generator provides coverage from 3 to 900 megacycles in eight bands, each one individually calibrated on the 6¼in etched aluminium dial.

Useful features of the instrument include electronic mixing of the sweep and marker signals, internal retrace blanking, internally provided crystal check points, dual sweep and marker amplitude attenuators, each triple-shielded, phasing control and calibrated wide and narrow sweep width controls.

Though provided with an internal crystal marker, whose output is separately accessible, the generator is intended for use with a separate RF generator, which may be any ordinary laboratory instrument of suitable quality and coverage.

Where such an instrument is not available, the "Precision" model E-200C is recommended.

Typical of some of the smaller items in the "Precision" range is the Series String Filament Checker, pictured at left.

Essentially a very simple item, intended to provide quick test for he continuity in tubes used in televisio ceivers having a series heater syste

Although pressure of work preve us from carrying out exhaustive ele cal tests on the above equipment, ins tion of actual units in our labora indicated careful design and construc

Full service facilities for the eq ment are being provided in Australia the agents.

Further details are available f Messrs R. W. Steane Ltd., of 2a M rose Street, Hawthorn, E3, Victoria, from interstate representatives. The dress in Sydney is 8 Gadow St Pymble.

☆

The model E-400 Sweep Signal Generator. The instrument is housed in a blue-grey hooded steel cabinet, with two-colour satin-brushed aluminium panel. Dimensions are 11 x 3 x 6⅝ins. and the price is quoted as £108/10/0. plus tax where applicable.

☆

TRADE REVIEW — A COMPACT VALVE VOLTMETER

illing the need for a compact et sensitive and accurate AC electronic voltmeter, this unit, alled the "Advac" was re-eased recently in this country y Jacoby Mitchell and Co. ty. Ltd., of 469 Kent St, Sydney. Manufactured by the well-known "Advance" firm in Eng-and, it is a high quality job.

HE instrument, type 77, has 12 ranges, covering full-scale readings n 1 mV. to 300 volts. It has a dwidth of from 15 c/s to 4.5 Mc/s, is also marked with standard dBm es — from -60 dB to plus 50 dB.

n output jack is provided, which en-s the inbuilt wide-band amplifier to ised for other purposes. This feature ld be very handy in laboratory work television equipment, serving as a stitute video amplifier of very high and stability.

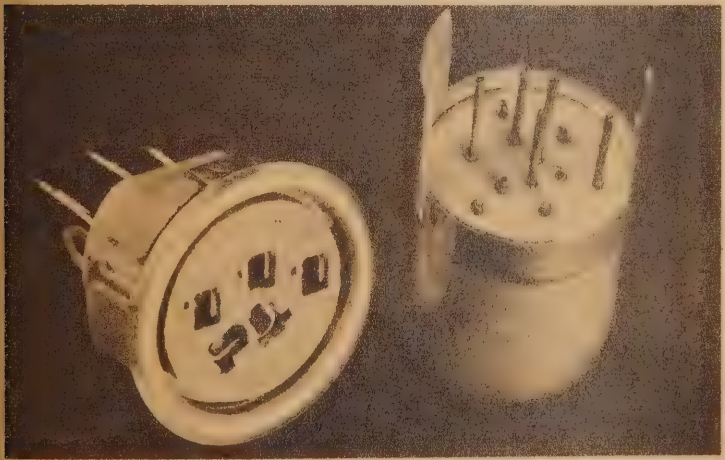
omplete with its well-shielded input (necessary on the low ranges), the rument is very portable, and quite t. The trade price is quoted as 2/10/ plus tax, and all enquiries uld be directed to the agents in Aus-ia, Jacoby Mitchell and Co. Pty. Ltd.

☆

This is the type 77 "ADVAC" electronic AC voltmeter from the English "Advance" firm. Compact and self-contained, it is extremely portable.

☆

RADIOTRON NUVISTOR RELEASED



Pictured above with its tiny socket is the first "Nuvistor" valve to be released in Australia. Weighing only 1/15 of an ounce and measuring only $\frac{3}{4}$in, it is a general-purpose triode, type 6CW4, supplied by the Amalgamated Wireless Valve Co. Pty. Ltd., of 47 York Street.

HE valve is constructed entirely from ceramic and metal using a light-ght, cantilever-supported cylindrical trode system. This makes for tremen-s ruggedness, and allows the parts e brazed together rather than welded. valves can also be evacuated and led at extremely high temperatures, ually eliminating gases and impuri-

his construction lends itself very l to automated assembly, and the hly accurate parts ensure very nar- characteristic "spread," as well as h improved reliability. Due to the struction, the valves may be operated at any altitude at full ratings (1 watt max. for this tiny unit).

Electrically, the 6CW4 is a medium-mu triode, with a transconductance of 11,500 micromhos (at 75 volts on the plate and at 10.5 mA). It has low inter-electrode capacitances (Cg-p is 2.2 pF), and is designed for operation at plate voltages up to 110 (absolute max.).

The overall construction and performance would recommend it to applications in industrial electronics, television, communications and all uses where ruggedness, reliability and close tolerance are at a premium. All enquiries should be made to the Amalgamated Wireless Valve Co. Pty. Ltd.

TRANSFORMERS FOR STEREO FROM A & R

A set of two identical output transformers intended for the Unit Stereo Amplifier No. 2, and other circuits using push-pull 6BM8's, was sent to us recently for testing and review. They are the A and R type 4005 units shown below.

ELECTRONIC
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EQUIPMENT
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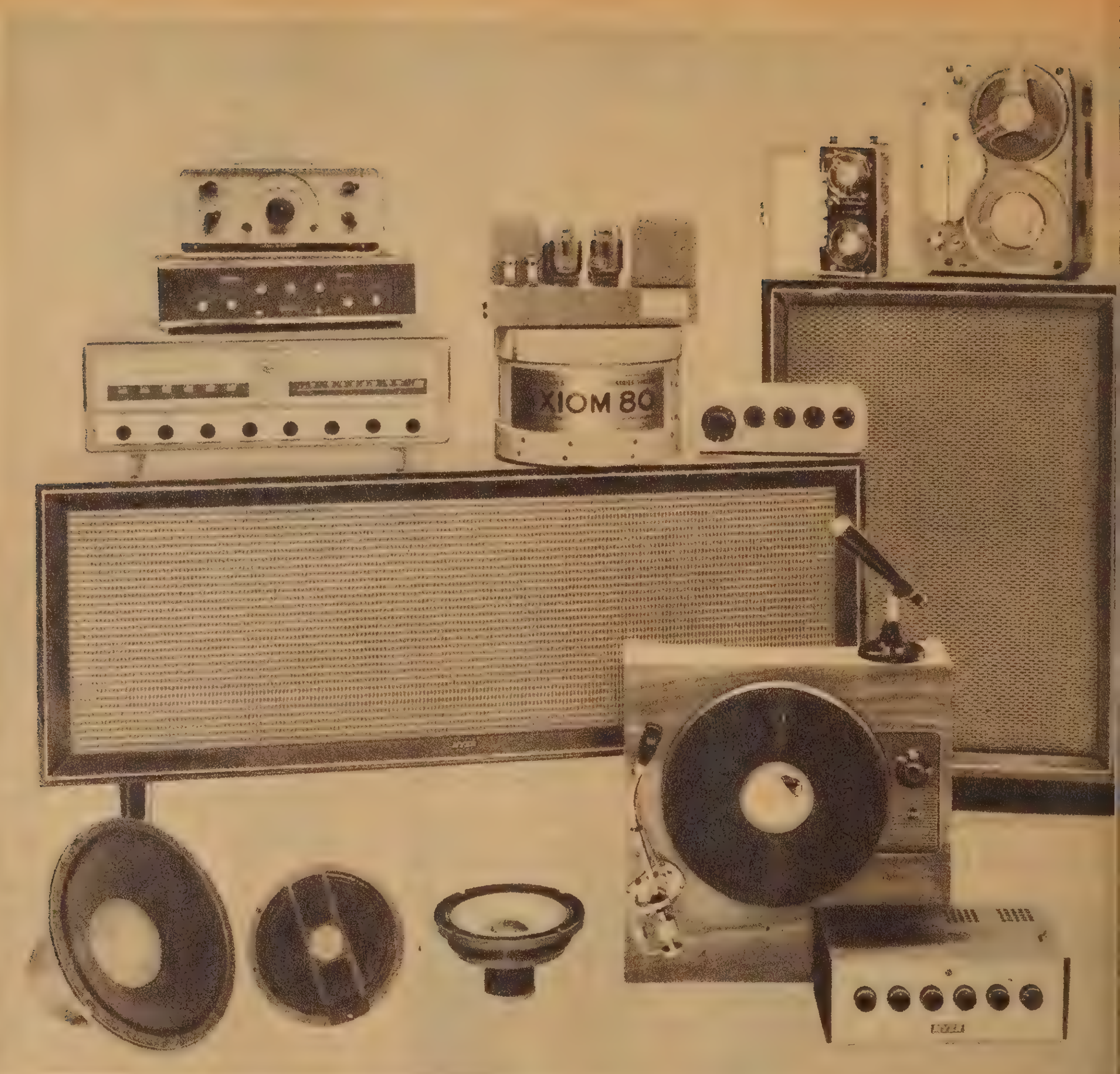
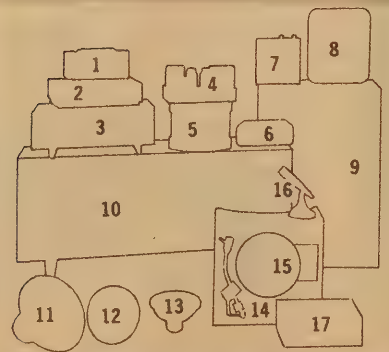
EQUIPMENT

SUBMITTED by A. & R. Equipment Co. Pty Ltd., of 378 St. Kilda Road, Melbourne, SC1, Victoria, the units are very well finished, and clearly marked. They are provided with a grain-oriented core, and have a published power rating of 7 watts at 30 c/s. Ultra-linear taps are brought out at 4% of the primary impedances, and secondary impedances of 3, 7, 7, 5 and 15 ohms are provided. They are thus quite suitable for the Unit Stereo No. 2 without modification, and indeed they perform very well.

The units are available through all the normal trade houses and suppliers.





1. Jason Audio Generator Kit. £28/10/-. **2.** Jason 20-watt Stereo Amplifier. 85 gns. **3.** Pioneer 17-watt Stereo Amplifier with AM/FM tuners. £149. **4.** Quad Power Amplifier. £61/5/-. **5.** Axiom 80 Free-Edge Speaker. £36/14/-. **6.** Quad Stereo Pre-Amp. £64/15/-. **7.** Fi-Cord Hi-Fi Transistor Tape Recorder. £121. **8.** Tandberg Model 5 Four-Track Stereo Tape Recorder. £266. **9.** De-luxe Vented Enclosure for Tannoy Monitor Speaker. 29 gns. **10.** "Horizon" Stereo Speaker Cabinet in single unit. Holds two 8" speakers. £28/10/-. **11.** Tannoy 12" Monitor Dual Concentric Speaker. £78/10/-, incl. X-over. **12.** Peerless 820/20 8" Co-Axial Speaker. £15/8/8. **13.** Goodmans Axiette 11 8" Wide Range Speaker. £16. **14.** S.M.E. Model 3009 Precision Pick-up. £39/17/6. **15.** Rola Professional Turntable. Synchronous motor. £76/8/10. **16.** Grampian DP4 600 OHM Dynamic Microphone. £20/3/-. **17.** Myer 10-watt Integrated Stereo Amplifier. 50 gns.

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ecords--In Review

(Continued from Page 105)

Arias in the Great Tradition—Recital by Eileen Farrell. Beet-oven: Abscheulicher, wo eilst du in? (from Fidelio); Ah, Perfido Concert Aria); Weber: Leise, leise from Der Freischutz); Cavatina from Der Freischutz); Cherubini: olo un pianto (from Medea); Gluck: Grands Dieux! du destin, qui n'accable (from Alceste). With the Columbia Symphony Orchestra con-ducted by Max Rudolf. Coronet tereo. KLCS 2697.

This is a stereo version of an impres-e mono disc issued earlier in the year. e music has gained in every way from transfer to two channels and what s originally a most enjoyable recital acquired new breadth, depth and ness. I can recommend it enthus-ically to all those on the lookout for nd, as opposed to merely pleasing, ging.

RECOMMENDED

zabethan Ayres, Madrigals and ances played by the New York Pro usica under Noah Greenberg. Festival ereo FST-11039T. Mono FL-7150.

umann—Carnaval. Chopin—Les Syl-hides. Played by the Philharmonia rchestra under Robert Irving. HMV ono OCLP 1296.

opin—Scherzi, Etudes, Fantasie, Pol-aise, Mazurkas played by Adam Har-iewicz. Philips Classical Favorites. ono GL 14.

Wiener Operette—Selection from ountess Maritza, The Gipsy Princess, he Tsarewitch, and the Bird Catcher, erformed by the Vienna State Opera rchestra and Choir under Josef Drex-r and Hans Hagen. Pye Mono 1LP-10.

World of Music—Items from Carmen, he Bartered Bride, Fledermaus, ugene Onegin and short pieces by ebussy, Brahms and others. Played by e Capitol Symphony Orchestra con-ucted by Carmen Dragon. Capitol ereo SP8412.

hms—Hungarian Dances. Dvorak—avonic Dances. Played by the Bam-rg Symphony Orchestra conducted by nel Perlea. Vox Mono APL-11240.

ria Callas Sings—Operatic Arias, me of them unusual, accompanied by e Philharmonia Orchestra conducted Tullio Serafin. World Record Club ono TE219.

bert and Sullivan Songbook—Popular oruses performed by the Ralph Hunt-Choir. RCA Mono L10886.

opin—Two Scherzos, Four Nocturnes d the Barcarolle played by Vladimir orowitz. RCA Mono L16221.

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AMATEUR BANDS WITH BILL MOOR

RD CONTEST POPULARITY GROWS

Another W.I.A. Remembrance Day Contest is past and even after 15 years since VP Day it is remarkable the number of post-war amateurs who clear the cob-webs and make a reappearance.

THE contest is now even better supported than when first conducted in 1948. It is often the only occasion during the year when ex-servicemen separated by hundreds of miles, but who served together during the war years, exchange words of greeting. It is a form of reunion for many radio amateurs.

OFFICIAL OPENING

The contest was officially opened by His Excellency, the Governor of Tasmania, Lord Rowallen, K.T., K.B.E., M.C., T.D., who recorded a tape for broadcast throughout Australia. His Excellency was quite well versed in amateur shortwave affairs as he in the past had constructed a shortwave receiver and listened at those frequencies. Lord Rowallen spoke of the service generally, its fascination, its value in the service of man and potential as a nucleus of trained personnel in time of emergency and war.

He discussed too the mode of operation of the contest, its purpose not as an individual event but as a teams event with all competitors assisting their own state in its quest for the perpetual trophy. His Excellency's final remarks were to the effect of letting the battle proceed and may the best team win. The address was relayed over official W.I.A. stations in all parts of the Commonwealth during the 15 minutes of silence prior to the commencement of the contest at 1800 hrs.

Tom Allen, VK7AL, introduced the Governor and at the completion of his speech read the names and callsigns of the personnel of the Army, Navy, Air Force and Merchant Marine, who gave their lives in World War II. Tom then recited Binyon's Ode to the Fallen.

Perhaps next year the few amateurs who operated during the 15 minutes of silence will read of the arrangements for the W.I.A.'s Remembrance Day Contest in 1961.

From 1800 hours the contest was really under way and as one competitor described it "it was no Sunday School picnic." It was a contest for big signals with no beg pardons especially during the opening hours. Each year with a growing number of telephony stations participating and fewer CW stations operating interference is a problem on 7 mc/s. A big signal was required to ensure you were not just in the background.

HIGH SCORES EXPECTED

Scores will be even higher than last year judging from remarks made during the postmortems at the completion of the event on the Sunday evening. A number of scores will be well over the 1,000 mark with some serial numbers over 400 (starting number unknown) being passed late in the afternoon. Conditions were quite good despite the threat of ionospheric storms scheduled for the Sunday. A few VK0, VK9 and VK8s providing the diversion.

The RD Contest is certainly a success. It is easily the best supported of all Australian contests, while the opening ceremony provides an opportunity to remember the amateurs, known to many of us, who no longer call "CQ RD" during the following hours.

WICEN OPS. IN ARMY EXERCISE

Wicen operators and other amateurs co-operated with the Army in August, reporting on signals emanating from a mobile unit travelling on the North Coast and Tablelands of N.S.W. The mobile operated on 6735 kc/s by day and 3382.5 kc/s by night and was a radio section of the 504 Air Support Signal Unit and travelled up the North Coast returning by the inland route. The station was housed in a 2½ ton truck and carried radio equipment to cover all frequencies including the VHFs.

Amateurs listened out for the Mobile Van at specified times and reported back to VK2AUX Blue Mountains section station, or VK2AUX/p, an amateur who acted as control station for the time. VK2AUX, at a fixed time, then broadcast a resume of the reports received, for reception and copy by Army stations.

A number of amateurs provided signal reports from various locations and the information should be of value. Army Signal authorities expressed their appreciation of the co-operation afforded.

Unfortunately most of the schedules were conducted during daylight hours with so many amateurs away at work. The fellowing stations were amongst those who provided reports or acted as control officer for the net. VK2ADT, VK2APP, VK2ASJ, VK2FP, VK2AWS, VK2ACP, VK2GI, VK2ATQ, VK2AWF, VK2XP, VK2CR, VK2MW, VK2GV, VK2ASF, VK2AXJ, VK2AHH, VK2DE, VK2ADN, VK2AJH, VK2WH, VK2AXH, VK2ACU, VK2AKC, VK2AVK, VK2NK, VK2YC, VK2TQ, VK2VU, VK2ADB, VK2XS.

SATELLITE NEWS

U.S. Project Bounce saw the 1 balloon Echo I in orbit mid-Aug Daily papers carried the story of tr American and trans-Atlantic comm cations via the balloon. Australian a teurs were active during suitable or of the balloon endeavouring to bou a signal to New Zealand. 144 mc/s tried from N.S.W. and the 50 mc/s b from South Australia. A number amateurs were active too recording appearance and fading of the ballo 108 mc/s signals.

Amateurs through the years on high frequency bands have covered s incredible distances with inputs of watts or so. The performance of 5-watt transmitter on the U.S. sp probe Pioneer 5 by comparison m interesting reading. The probe was o inally launched from Cape Canaveral March 11. After two months it bec apparent that the transmitting unit almost reached its transmitting limit it was decided to energise the 150- transmitter.

The 5-watt transmitter had done g service for a distance of 8.001 mil miles — DX at its best.

CLUB NOTES

Radio clubs are being establishe many country towns showing a hea growth in the amateur service. T provide radio and morse tuition and opportunity to meet other enthusi The latest Radio Club to be formed i Yass. Interested persons in the area obtain further information by cont ing Roy Rayner, VK2DO, 42 P Street, Yass.

New officers for the ensuing year the Griffith Radio Club are, presi Ted Druitt, VK2AXD, and secre Evan Savage, VK2ACS.

The Southport Amateur Radio C Queensland, also held their annual m ing at their clubrooms, 8 Bellview ade, Heydon Heights, Southport. following office-bearers were elec president, Bob Kyle; vice-president, Ruck; hon. sec., Ray Rumble; hon. tr Rhys Yarrow; class master, Bill Se and librarian, Reg Carter.

The club is planning an Ama Radio Display for the Gold Coast Sp Festival to be held during October

HUNTER BRANCH

Lecturer at the August meeting o Hunter Branch was Barry Good VK2ZAG, who took as his su "Components at VHFs." The le was very popular and showed wha use when moving to the higher b At the September meeting Allan hall, VK2KB, told and displayed s of his recent trip to the East.

Of value to listeners who cannot the Sunday morning broadcasts VK2WI is the Monday evening re provided by the Hunter Branch.

Over their station VK2AWX broadcast a session covering outs ing items of the VK2WI broadcast.

nences at 1900 hours East on a position close to 7050 kc/s.

uring Education Week, in August, umber of amateurs co-operated to ide a demonstration of Amateur o to pupils, parents and the like. amateurs installed equipment at chools, in other cases school stations ated. Callsigns used in the demon- ion were VK2VU, VK2IN, VK2. I, VK2DE, VK2AKX, VK2ATQ, FQ.

ank Pearson, VK2ACQ, new presi- of the Narranderra Radio Club, is in charge of the N.S.W. Division Morse Transmissions. Frank ar- es the roster and makes sure a sta- appears each evening. Practices mence at 1930 hours EAST each ing on 3525 kc/s and normally runs 45 minutes, plus a final 15 minutes reports from other stations are re- d. This latter period provides exer- in receiving normal amateur trans- ions, the callsign used is always AWI.

ans are already being discussed for N.S.W. Division, 1961, Australia Day end Convention and preparation is underway at Dural. A three-day event is generally envisaged commencing with the Monthly Meeting on the Friday, a day at Dural on the Saturday and Sunday is set aside for a mobile rally.

Returning to the N.S.W. Disposals Committee are two disposals stalwarts Alec Dan, VK2ABU, and Harry Solomons, VK2AJZ. Together with Allan Williams, VK2FH, they were responsible for obtaining most of the equipment made available to N.S.W. amateurs in the past.

The changes in the N.S.W. Division's Monthly Bulletin are very welcome and it should be of even greater interest to members. It has been registered as a periodical and Vol Molesworth, VK2VO, takes over the position as editor. It provides up-to-date news of N.S.W. Divisional activity.

The Gosford Radio Club, Central Coast section of the WIA, have arranged their well-known annual convention for Sunday, November 20th. These events in the Brisbane Water area have been conducted for over 25 years and full publicity on the event will be provided later.

WIA & DIVISIONAL ACTIVITIES

e Wireless Institute of Australia is officially recognised body represent- he Australian Radio Amateur, and ties provided also cover short-wave ers. All members receive monthly ateur Radio," the official journal of nstitute, which covers amateur and wave activity. The institute pro- many other services by way of re- ntation at International and Na- l levels, classes, lectures, QSL u, conventions, field days, and other ities of value and interest to the siast.

ERAL EXECUTIVE

e Federal Executive of the WIA, esent located in Melbourne, man- the Institute in that sphere and divi- l headquarters are located in all capitals. Intending members, either eur or short wave, should contact State Division by letter addressed to ecretary.

e more members in the institute ore effective representation and the er facilities they can provide. It is tial in times of frequency allocation ssions that the voluntary workers in VIA should have every support. The ving are the addresses of the vari- divisions of the WIA to which in- s re membership can be directed:

w South Wales: 14 Atcheson Street, s Nest.

ctoria: 478 Victoria Parade, East ourne, C2.

eensland: Box 638J, G.P.O., Bris-

th Australia: Box 1234 K, G.P.O., ide.

stern Australia: Box N1002,)., Perth.

mania: Box 851J, G.P.O., Hobart.

N.S.W. Division's AOCP Corres- nce Course has been available for purposes for intending amateurs arly three years. Perhaps the most sting feature of the course's appli- has been the use of the prepared papers for class instruction purposes in radio clubs. The whole course of 48 lessons covering theory and regulations is made available to clubs at a nominal fee for individual member students.

Some thirty clubs in N.S.W and Queensland use the lessons for class notes. They have proved very valuable and recently a number of inquiries have been received from Victorian clubs. In cases where persons are isolated and cannot attend club meetings the correspondence course is available through the N.S.W. Division of the WIA. The service provides the study papers and questions and papers on return are corrected. Full information on this course and the normal AOCP course held in Sydney can be obtained from the class supervisor.

A letter to Norm Beard, VK2ALJ, clas supervisor, WIA N.S.W. division, 14 Atcheson Street, Crow's Nest, is all that is necessary.

It is interesting to note that in all States of Australia, except VK9, ex-students call signs now appear in the call book. The course as mentioned covers theory and regulations. For Sydney students morse practice is available at Atcheson Street on Monday evenings and for all each evening on 3525 kc/s from 1930 hours EAST onwards. Call sign, VK2AWI.

LECTURES

Lectures provided in August included one from Lindsay Douglas, VK2ON, presented to the Central Coast section of the WIA, N.S.W. Division, on frequency meters. Lecturer at the N.S.W. Division's general meeting was Mr Harrant, of the P.M.G.'s Department, who described VHF and micro-wave equipment and techniques. The field covered was one about which most members had little knowledge and it was illuminating to learn of the department's telephone multi-channel radio links. One circuit produced of equipment in use was 25-feet long.

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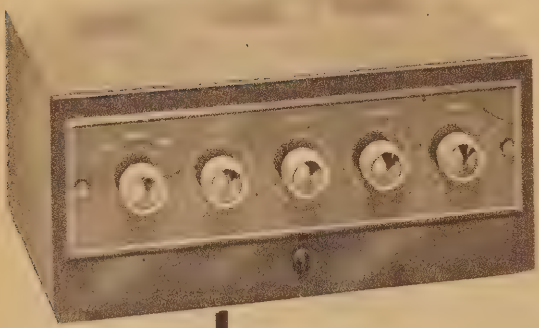
"MULTI-PURPOSE" AMPLIFIER CHASSIS KIT

Great News for Home Constructors! A new all-purpose Universal version of the famous A. & R. 5 Stereo 7 Amplifier Kit. Similar in outward appearance, this new kit provides for a variety of monaural and stereo circuit arrangements, including pre-amplifier sections to cover the use of high and low level pickups. Here are some suggestions as to the units you can build:



PUSH PULL EL 84 STEREO AMPLIFIER

A stereo amplifier and pre-amplifier control unit described in R. TV & H. December, 1959. The single valve pre-amp can be incorporated for a crystal pickup, or for low output pickups the EF 86 circuit in R. TV & H. June, 1959 can be used.

UNIT AMPLIFIER No. 2 (R. TV & H. AUGUST, 1960)

The kit provides ample accommodation for monaural amplifiers such as the Mullard 5/10 (with or without pre-amplifier) and for possible extension later to a stereo unit. The "Universal" Kit has unlimited possibilities — see it NOW!

MULLARD 5/10 — or your own STEREO

Another stereo amplifier using p.p. 6 BM 8's in each channel is described in R. TV & H. for August, 1960. This is the "Unit Amplifier No. 2" and is a self-contained circuit with all facilities matching the A. & R. "Universal" Kit escutcheon plate. The layout of parts can be arranged to suit the "Universal" Kit without difficulty.

Full Technical Details from your nearest A. & R. Distributor

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ıe meeting Roy Pearce, VK2IV,
ɔn co-operation with the Sydney
ır Astronomer's group and work
lio amateurs could carry out. The
of an additional monthly meet-
; also announced. It will be held
ıinistration Headquarters, Atche-
eet, and will cover technical fea-
Leo McMahon, VK2AC, will pro-
: first demonstration and talk on
ınd RF frequency measurements.

N.S.W. VHF and TV group's
y evening transmitter hunt re-
in a win for Ron Graham,
G.

:cond place was Jim Cummings,
1, third Phil Pearson, VK2ZBB.
x was a team of old-timers of
:pute, Harry Lapthorne, VK2HL,
Fryar, VK2NP, and Bill Bardin,
Z.

Taylor, VK2ASQ, due to a
of QTH, has relinquished the
of assistant QSL manager,
Division; his successor is Syd
VK2SG, who will look after the
ls cards section of the bureau.
Hine, VK2QL, remains as divi-
QSL officer.

ND TV SECTION

Slight, VK2ZA, provided an in-
g lecture to the N.S.W. VHF and
:tion in September to some fifty
rs. Xtal etching and grinding was
and undoubtedly some of the
populated sections of 144 mc/s.
relief.

Blue Mountains section of the
ill hold their annual field day on
, October 30, in the bushland
ıding the Lawson Swimming Pool.
:ation, an easy drive from Sydney,
a good crowd from the metro-
The weather in the lower moun-
ideal in October and the venue
an ideal location for a family out-

ɔmprehensive program has been
d and registration will commence
.m.

morning session comprises a 144
ransmitter search and heats of the
d hunt. The afternoon covers 7
4 mc/s. scrambles, disposals sale,
ıls of the blindfold event. For the
ınd children there will be a con-
bus tour of the mountain scenes.
ellent prize list has been arrang-
the usual free ice-creams and
will be dispensed. All will be
e at the Lawson pool on Octo-
Proceeding from Sydney, turn
ver the railway bridge, bear left
: entrance to the pool is on the
ıst past the bowling club. Notices
displayed.

. DX CONTEST

he time these notes appear, the
ıy section of the 1960 VK/ZL
ntest will be over, but the CW
should just be coming up. This
vent is conducted by the NZART.
Z. and Australian national socie-
e it in turns to conduct the con-
'he CW section will run for 24
rom 1000 GMT, Saturday, Octo-
o 1000 GMT, Sunday, October 9.
mateur bands may be used, but
s band working is permitted.

one contact per band is permit-
:h any one station for contest
s.

The usual cypher group must be exchanged comprising the RST report and three other figures which may begin with any number between 001 and 100 and increase by one for each additional contact.

VK and ZL stations score on the following basis: Five points for each contact on a specific band and in addition for each new country worked on that band bonus points on the following scale will be added: First contact, 50 points; second contact, 40 points; third, 30 points; fourth, 20 points; fifth, 10 points.

For this purpose the ARRL countries list will be used with the exception that each call area in the U.S.A. will count as a scoring area.

LOG SHEETS

Logs and summary sheets should be submitted in the usual manner. They should be directed to reach the NZART contest manager, Jock White, ZL2GX 86 Lytton Road, Gisborne, New Zealand, before December 20, 1960.

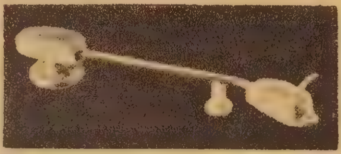
To ensure the Amateur Radio Service is represented at all levels National Societies are grouped together in the International Amateur Radio Union. The union, with its headquarters in the U.S., provides for the exchange of ideas between societies whose combined membership would approach 200,000.

The Region 1 International Amateur Radio Union Conference held this year at Folkestone, England, saw representatives of 18 IARU member societies in Europe assemble, together with the secretary of the IARU, Arthur Budlong, W1BUD (general manager of the HQ Society the ARRL). It is the fourth of these conferences to be held, the first in Switzerland, 1953, the second, Italy, 1956, and the third in Germany, 1958.

Besides the plenary meetings at the beginning and end of the conference, three committees sat in session over three days.

These committees covered administrative and operational subjects, technical and VHF divisions. Their deliberations were presented to the final plenary meeting for consideration.

AWA RONETTE
Wide Range FONOFLUID PICK-UP



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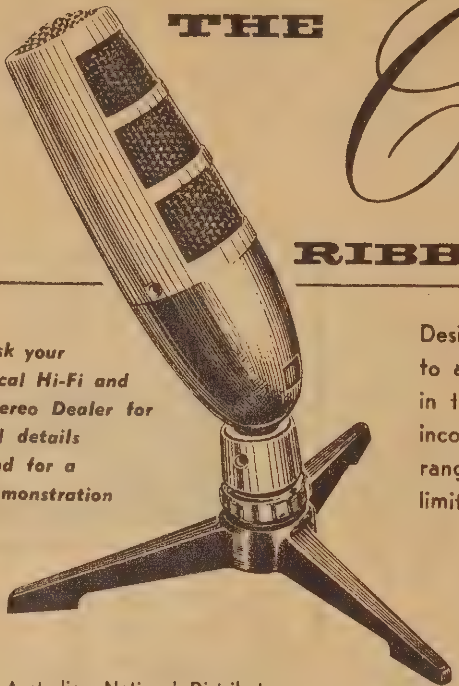

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Ask your local Hi-Fi and Stereo Dealer for all details and for a demonstration

Designed to provide performance to the level of that hitherto associated with studio class equipment, whilst remaining in the medium price bracket, this new ribbon microphone incorporates a new conception of ribbon and magnet arrangement giving an output which is flat to within close limits over the wide range from 50 c.p.s. to 12,000 c.p.s.

Sensitivity: (Open circuit) High Impedance: —58 dB ref. IV/dyne/cm2 (Open circuit) Low Impedance: —93 dB ref. IV/dyne/cm2 or with suitable line transformer: —58 dB ref. IV/dyne/cm2

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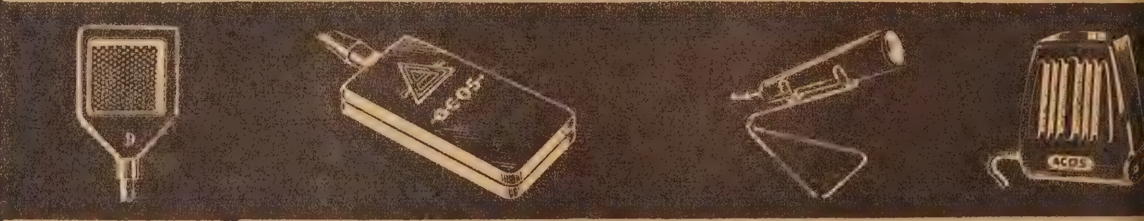

LAPEL MICROPHONE MIC28
Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft moulded rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel.
PRICE: £5/19/6.

VIBRATION MICROPHONE TYPE VP1
The VP1 Vibro-Voice has been specially designed for use with guitars, double bass and, in fact, all stringed instruments. With the use of this simple yet effective pick-up, together with a good quality amplifier, any instrument can be amplified. The VP1 has ample output and a frequency range which extends to approx. 6 K/cs. The tough rubber case protects the instruments from damage.
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CRYSTAL STICK MICROPHONE MIC39-1
The MIC39-1 has been beautifully styled as a hand, desk or floor stand unit, and precision engineered to the highest professional standards. A heavy die-cast liner in the microphone case eliminates the possibility of hum pick-up due to hand capacity effects. The use of a special noise-free cable improves screening and gives a greatly increased signal-to-noise ratio.
PRICE: £7/19/6 complete.
Desk stand extra.

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colour to give
handsome, qua
Microphone
modest dimensi
and unassum
price. Ideal
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a minimum of st
age space av
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ON SHORTWAVE BY ART CUSHEN

WAN ISLAND HEARD ON 6Mc.

ception of the tiny Swan Island, which is now broadcasting on short
ve, has been noted in the afternoons. Signals are good and the
ogram appears to be shared with the local broadcast channel.

S tiny island, 90 miles off the coast
f Honduras and 300 miles from
is the centre of much con-
sy, as its broadcast seems to be
d by the Cuban Government. The
went on the air first with 50 kw
broadcast band frequency of 1160
nd it is presumed the short-wave
ission from 1 to 3.00 p.m. is using
ansmitter also, as the 1160 Kc.
is on the air from 11.00 p.m. to
.m. the next day. The signals on
Kc have been good, with a news
n in English following the pro-
at 1.55 p.m., then Spanish is broad-
om 2.05 p.m. This session gener-
rminates at 3.00 p.m., but on oc-
s broadcasts have continued to
.m. The station asks for reception
to Radio Swan, General P.O.
1247, New York City 1, N.Y.

station is owned by the Gibraltar
hip Company and the long time
between the United States and
ras over the ownership of the
resulted in the station commenc-
oadcasts without the F.C.C. ap-
. The United States for some years
aintained a meteorological station
island, and the land is actually
by the Sumner Smith family of
, U.S.A.

sels Using 6050 KC

Belgian Radio and Television's
verseas service has been heard on
w frequency of 6050 Kc with its
ission in English to 7.00 a.m. The
m is concluded at this time, and
ign off is made the B.B.C. trans-
on the same frequency comes on
in the European service and is
y jammed. The Brussels program
news on the Congo and music.

From early July the Brussels station has been on an extended schedule, which is as follows, 3.00-4.00 p.m. 15385 Kc, 17845 Kc, 21510 Kc, from 4.00 p.m. to 3.00 a.m. on 17845, 21510, 21730, 3.00 to 7.00 a.m. on 15285, 17845 and 17860 Kc, and 7.00 to 9.00 a.m. on 9745, 15285 Kc.

New Dominican Station

SIGNALS from a new station in the Dominican Republic have been noted by Miss Dorothy Sanderson in Malvern, Vic., when the station was heard on 9500 Kc. The station has been heard on Sundays from 3.45 p.m., and at 5 p.m. makes an identification announcement in English.. Following this announcement, news summaries in English, French, German and Spanish were broadcast, and the station left the air at 5.30 p.m. Reception has been good throughout the whole listening period from 3.45 to 5.30 p.m. on this frequency of 9500 Kc. This is the only broadcast in English at the moment from this West Indies Republic, and its service seems to be directed to listeners in the United States with its transmission times suitable also for reception in the Pacific area. Radio Dominicana, the other best received station in this country, is heard with broadcasts from Ciudad Trujillo on 5970 and 9735 Kc from opening at 8.45 p.m.

The further monitoring of the signals of "Radio Carebe" show this new station is operated by the Dominican Government, and also uses the slogan Radio Nacional. The station appears to be of a varying schedule, and when closing at times without the foreign language programs, has transmissions only in Spanish to 5.00 p.m. The sign-off announcement translated shows that they operate two shortwave stations, HI2U on 6090 Kc. and HI3U on 9500 Kc. The sign-off announcement also lists six broadcast band transmitters, HIU, HIUA, HIUB, HIUD, HIUE, HIUF, as well as the shortwave stations. The key station of the whole network is HIU in Ciudad Trujillo, which operates on the broadcast band frequency of 1240 Kc. The station in its Spanish transmission plays popular music with the slogan between each item, and following the sign-off announcement at 5.00 p.m., plays the Dominican National Anthem. Signals continue to be received strongly on 9500 Kc. after XEWW closes at 4 p.m., but 6090 Kc. is subjected to interference from VLI6 in Sydney also on 6090 Kc.

Dakar Now Using 100 KW

MALI, the former French West Africa, is this month reported with better signals since the announcement by the station that transmitter power is now 100 Kw. The Dakar station has news in French at 6.00 a.m., and this is followed by the National Anthem of the new Federation of Mali at 6.17 a.m. News in English is carried at 6.20 a.m. and the service is on 7210, 11895, and 15385 Kc. Another report is the reception of the station, when opening at 4.30 p.m., when it identifies as "This is Radio Mali, the radio station of the Federation of Mali, broadcasting from Dakar." The afternoon service is on the air from 4.30 to 6.00 p.m., and is best received on 15385 and 11895 Kc. North American listeners report the afternoon reception as good, but in this area some jamming on the frequency plus the close proximity of the B.B.C. signals on 15390 Kc. are the main deterrent to otherwise good signals.

Canary Islands on 7295 Kc

RECEPTION of the Canary Island station EAJ8AB on 7295 Kc. has been noted from sign-on at 7.00 a.m. The station suffers from some side interference from the Berlin station, which at this time is using 7300 Kc. Radio Tananarife in Santa Cruz also has been noted in Europe, when signals can be heard to a later hour and reception is possible from 9.00 a.m. and 10.15 a.m., though at times signals have been noted to sign-off at 9.45 a.m. The station has broadcasts in Spanish and offers entertainment mainly of light Spanish music, and frequent announcements of the slogan are given.

Quito on 3725 Kc

RECEPTION of a low frequency of the Quito station has been noted on 3725 Kc., a frequency in the centre of the 80-metre amateur band subject to considerable interference. The station HCGB1 has been noted as early as 4 p.m. in its transmission, which is now on the air for 24 hours of each day. The program is of light dance music with frequent announcements in Spanish with the station slogan "Radio Nacional Espetejo" given from time to time. This station, which also is heard on its other frequency of 4650 Kc. has been one of those few South Americans with a 24-

0 Kw TRANSMITTERS FOR FIJI

Fijian Broadcasting Commission
s announced that two new 10 Kw.
itters are to be put into opera-
late 1961 to give coverage on
ave for the complete area of the
. Amalgamated Wireless are to
ct the transmitters, valued, with
at £50,000. They will be able
smit on frequencies from 9 to 4

ne moment the transmissions are
on VRH4 of 500 watts on 3980
1 two 250 watt stations VRH5 on
d VRH6 on 6005 Kc. These latter
tions are on loan by the Fiji Post
elegraph Department, and they
en on the air for several months
st basis to test new aerial systems,
ve that vertical radiation will give
ired coverage of Fiji. These new
tters will be installed on a 105-
acre area at Naulu, 8 miles from Suva, in marsh land, which will be of immense value to the propagation of the signals.

A new receiving site also is to be established with improved aerials, and this will give better rebroadcast reception of overseas news sessions from Melbourne and London. The F.B.C. hopes that, with this new type of transmission, areas 25 miles from Suva will receive better signals, and those inside this area will be served by the existing broadcast band stations.

The present broadcasts are in English on VRH4 on 3980 Kc and VRH5 on 5980 Kc 4.00 a.m. to 8.30 p.m. The vernacular language broadcasts, Fijian and Hindustani are on VRH6, 6005 Kc, which operates from 4.00 a.m. to 8.00 p.m.

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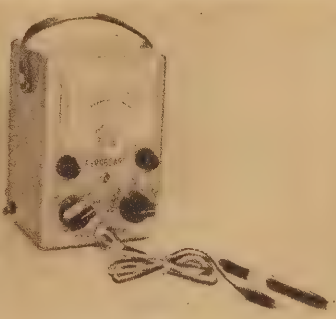
SUBSIDIARY OF
MOTOR SPARES
LTD.



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Model P.V. 33

Ideal for amateurs and servicemen of radio and television and for all electronic work. Measurements can be made of AC and DC voltages. 0-1.5, 5, 15, 50, 150, 500, 1500. Decibels minus 10 to plus 65 in 7 ranges. Zero Centre DC voltage indicator.

Ohms from 0 to 100 megohms in 7 ranges.

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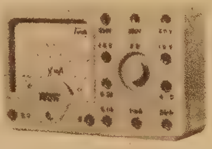
Dimensions 4¾ x 4¾ x 7 inches, weight 3½lb. **Price £19/10/** plus 12½ p.c. sales tax £2/8/9, **a total of £21/18/9 plus postage.** High Voltage Probe, **£3/3/** plus 12½ p.c. tax 7/11 total of **£3/10/11** plus postage. RF Probe, **£2/6/6** plus 12½ p.c. tax 5/10, total of **£2/12/4 plus postage.**



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Model PT34, overall size 3¾ x 2¾ x 1¼ inches.

Sensitivity of meter 1,000 ohms per volt.

AC and DC voltage 0-10, 50, 250, 500, 1,000.

DC current range 0-1mA, 100mA, 500mA.

Resistance 0-100,000 ohms.

An efficient meter at a cheap price.

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Record Changer as above—but mixer type, very well-known make, very reliable, will give excellent tone and performance.
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RECORD PLAYER AMPLIFIER. Latest type English four-speed record player with turnover head, pickup and two sapphire styli in handsome case finished in two-tone green, red or fawn. Amplifier has variable tone control. Ideal for parties, dances, etc., also for music lover. **These are a really good buy for £19/19/.**

4-SPEED RECORD PLAYER IN LEATHERETTE COVERED CASE, with automatic stop, turnover head with 2 sapphire styli, plays standard and microgroove recordings All colours available. Worth 19 gns.
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SPRING GRAMOPHONE MOTORS. Wind-up type suitable for replacement in Portable Gramophones and also for hobbyist, complete with turntable and all fittings. **10/ ea.**

SOUND BOXES for above spring gramo. **7/6 ea.**

TONE ARMS FOR ABOVE, 6/ ea.

4-SPEED GRAMO MOTORS to operate from 240 volt supply. Each has speed control knob for 16, 33, 45 and 75 r.p.m. and also on-off switch. A good reasonably priced motor. English make, brand new and boxed.
Price, only £5/10/.

IMPORTED PICKUP ARMS with turnover crystal cartridge and 2 sapphire styli, ideal to use with above 4-speed motor or similar job. **Price only 35/.**

4-SPEED RECORD PLAYER UNITS consist of motor and turnover head pickup, mounted on unit plate so that it is easily built into Radiogram, etc. Automatic stop, English make, brand new and boxed **Price only £10/19/6.**

4-SPEED STEREO RECORD PLAYER UNIT, as above but for Stereo. **£12/10/.**

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1. Speaker Windings. We have a large variety of these to suit all popular makes of speakers. When ordering let us know size and make of speaker and primary impedance of old transformer. **1/11 each.**
2. 5mm Ignition Cable, solid rubber insulation, a really good buy at **6d per yd.**
3. 10,000 ohm carbon potentiometers, only **2/ ea.**
4. 25,000 ohm carbon potentiometers, only **2/ ea.**
5. 25,000 ohm wire wound potentiometers, only **3/9 ea.**
6. 60mA Chokes in square metal can, **5/ ea.**
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9. Twin trimmer Condensers 100p capacity on Trolitol base, onl **1/ ea.**
10. 250 ohm Relays with 1 singl pole and 1 single pole doubl throw switches. Brand ne P.M.G. type. **Price only 5/9 ea.**
11. 815 push-pull beam power ampl fier valves for RF at high fr quencies. Will give up to 60 wat output. **Price only 25/ ea.**
12. 250 ohm Rheostats, 25 watt. very robust job with mica an porcelain insulation. **Price on 4/6.**
13. Inverters. A. 6 volt DC to 240 AC B. 12 volt DC to 240 A These are ideal for operatin mantel radios. Battery and A portables, small amplifiers, ele tric shavers, etc., from your c battery. They are not suitable f operating synchronous moto such as record players, etc. strong metal box finished in gr hammertone enamel. Wor £12/10/, to clear at **£5/19/6**
14. 1 pole 12 position 2 bank waf switches, **7/6 ea.**
15. 2 pole 5 position 2 bank waf switches, **5/ ea.**
16. 3 pole 5 position wafer switche **2/6 ea.**
17. 1 pole 3 position 13 bank Waf Switches, **5/ ea.**
18. 50yd. rolls 23/0076 250 vo single rubber covered cable wi woven cotton outer braid. Wor 25/, **our price 9/6.**
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20. Bargains in Carbon Resisto These are all new resistors various makes and are in go condition. Prices are given f single resistors and quantities 12, or 100 and these may made up of a variety of differe values of same wattage.

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BRANCHES THROUGHOUT VICTORIA AND RIVERINA

day schedule, and its signals in ea can be heard from 4 p.m. to p.m. The station HCGB1 has iling address of Calle Esmeraldes Quito Ecuador.

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lashes from verywhere

DAGASCAR signals are reported k Pollard, of Golden Downs, N.Z., g heard on the frequency of 3232 This broadcast from Tananarive en heard in the local Malgash lan- from 8.30 a.m. Nearby Mauritius on 3325 Kc. with the broadcasts orest Side and heard at 3.00 a.m.

ZILIAN signals at night have oted in New Zealand on unusual equencies, and the main signals nclude ZYR89 on 3295 Kc. in Sao at 7.30 p.m., while ZYV30 on c., is noted at 8 p.m. In the 60- band on 4985 Kc. the signals of at Manaus is heard at 8.30 p.m.

NESE station Radio Peking has oted in its program in Japanese eral frequencies, one in partciular 5 Kc from 7 p.m., which causes interference to CKNK of Radio in its transmission to Australia w Zealand. The Japanese broad- rom Peking are now carried on 9.00 p.m., 8.00 to 10.00 p.m., .30 to 11.30 p.m., using 4620, 510, 9590, 11945 Kc. The service m midnight to 1.00 a.m. on 4620, 590 Kc., and from 7.00 to 7.30 4620, 600, 9510 Kc.

A station at Gauhati, operating "A" program in Assamese, is on 11.15 a.m. to 1.00 p.m., on 7150, .m. to 11.15 p.m. on 4775 Kc., .m. to 2.00 a.m. on 4940 Kc. The ogram of Gauhati is on the air, al dialects, at 11.30 a.m. to 12.30 6130 Kc., 8.30 to 11.00 p.m. 5, and 11.30 p.m. to 1.00 a.m. on c.

ROVIAN station ELWA in the capital is frequently in the nd this month the altered chan- transmission to North America teners in this area probable re- during the morning hours. The American service is now on the dnesday from 11 a.m. to 1.45 n the announced frequencies of nd 21515 Kc. The reception of als in the 25 metre band is re- as good in North America and quency measured in the channel 3 Kc., while the additional fre- of 15080 Kc. is also reported This channel, however, is de- on the air with the transmis- the Congo Republic, which is from 12.15 to 4.00 a.m. MON- ation TRANS WORLD RADIO, as the former Voice of Tangier t was forced to close from that sion point late last year, is be- rd with its first test broadcasts onte Carlo. The station has been Europe on 7132 Kc., and the as a German service from 6.00 a.m.

LILAND REPUBLIC which formed from the former Bri- l Italian Somaliland, with its at Mogadiscio is reported to have commenced its new broadcasting service. Programs from the Mogadiscio stations have been noted on 4970 and 7150 Kc. The Mogadiscio station has been reported on the air from 7.30 to 9 p.m., 11.00 p.m. to 1.30 a.m. and 2.30 to 5.00 a.m. The programs are in Somali, Italian and Arabic, but the Mogadiscio station also plans to include English transmissions shortly. The former British station at Hargeisa is not mentioned, and it is presumed it continues to cater for the English listeners.

BELGIAN CONGO, is heard on the new frequency of 4839 Kc. and has been heard with programs in French and in African dialects from 3.30 to 5 a.m. The station has a news bulletin in French at 4.30 a.m., and the station has been heard asking for reception reports and some comments as to the programs listeners would like to hear.

NOTES from readers should be sent to ARTHUR CUSHEN, 212 Earn Street, Invercargill, N.Z. All times are Australian Eastern Time.

ARGENTINA is reported at better strength on its transmission to North America (which we hear in 9690 Kc. from noon to 2 p.m. with programs in English) than on its recently acquired channel of 11725 Kc. This latter session is on the air for Europe from 5 a.m. to 11 a.m. with English at 9 a.m., but reports from Europe speak of severe interference, also experienced in this area, from Hilversum using 11730 Kc.

BOLIVIAN station "Radio Libertad" broadcasting on CP30 listed on 6135 Kc. with 150 watts, and the station broadcasts from 9 to 11 p.m., 1 a.m. to 5 a.m. and 7 a.m. to 2 p.m. The station, though listed on 6135 Kc., is heard on an actual frequency of 6230 Kc.

DUTCH NEW GUINEA station Radio Sarong, which has been active on 3380 Kc., has terminated its broadcasts. The station was operated by an oil company for entertainment of the staff, and it ended its broadcasting in July.

MEXICO station XEHH, which is heard on 11880 Kc., Radiodifuroras Commercials, has also been reported on 15110 Kc., and uses the callsign XERR on this frequency, station has been heard closing at 4 p.m.

RUANDA URUNDI, with its station Radio Usumbura, has been noted now on 6195 Kc., with 3,000 watts, and is on the air from 1 to 4.30 a.m. Programs are in French and Urundi languages. The station address is P.O. Box 1.400 Usumbura.

CONGO REPUBLIC of the Franco African community has also been making changes in its radio transmissions, and the latest news is that "Radio Inter-Equatoriale, Brazzaville" has ceased operations.

RUSSIAN home service programs from the States of the Soviet are often heard, and the latest news from "Dxing Horizons" gives some of the regional stations as follows, Radio Estonia Tallinn, 6085 Kc., 5 to 9 a.m., Radio Georgia Tiflis, on 5040, is on the air 2 p.m. to 8.20 p.m. and midnight to 7.05 a.m., also on 4540 with programs in Armenia, 1.15 to 4 a.m. Radio Azerbaidjan, Baku on 4958 Kc., noon to 7 a.m., relays local programs. Radio Armenia, Erevan, 5740 Kc., from 12.30 p.m. to 7 a.m., Radio Karelia in Petrozavodsk, uses two outlets, 5065 and 6055 Kc., in Karelian, Finnish and Russian, with relays from Moscow. Radio Keiv, Ukraine has been noted on 6020, 11720, 11735, 11890 Kc. with relays of home programs.

LAOS with broadcasts from Vientaine has been noted with better signals, suggesting that the recently installed 10kw transmitter is now in regular service. Broadcasts on 6150 Kc. have been heard in Japan from 9 p.m. in Laotian and at midnight French is broadcast to sign off at 1 a.m., the same program of Radio Laos is also broadcast on 7143 Kc.

VACUUM MOUNTED CRYSTALS

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general studio use (for roving and orchestral pick u
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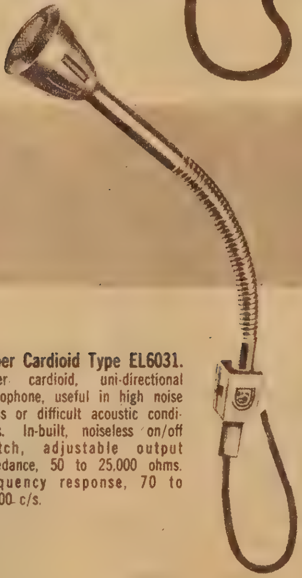

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ANSWERS TO CORRESPONDENTS

G. (Kogarah, N.S.W.) asks us what Phase Shift Oscillator, what are d, dual and concentric potentio- s, and why a microphone connected e aerial and earth terminals of a set only operates when the set is to a station.

Well, A.G., that's a bit of a tall but we will see if we can briefly he answers. A phase shift oscillator ually spoken of is a single valve oscillator which has a capacitance- nce network connecting the plate t and the grid circuit. The network arranged that at one particular ency the phase shift reaches 180 s, and thus positive feedback , producing oscillations at that ency.

ged or dual potentiometers consist o potentiometer units, with elec- y separate connections, mounted er so that they are rotated by the knob shaft. Concentric potentio- are similar except that the two each have their own shaft. One passes through the centre of the and a separate knob is mounted ch shaft, one knob being mounted l the other.

microphone is not normally con- to the aerial and earth terminals set, but to the pickup terminals, y via a preamplifier. However, since ont end of a radio is only receptive nals of radio frequency, the micro- cannot be fed straight into the and earth terminals in the absence y RF carrier. Apparently what ns when such a carrier is present t the microphone modulates the and the set then treats the signal normal modulated carrier and pro- an output.

.R. (Newport, Vic.) suggests that about time we featured a good unications type receiver since it is time now since such a circuit was ned. He also would like to see details of the various wavelengths equencies used by amateurs, ship- broadcast, etc.

A good communications type re- would require a great deal of nd much experimentation, and for eason may have to wait a little In any event a more satisfactory ch, in many respects, is that of g one good single band receiver aking up a series of converters for nds required. This is more likely the line which we might adopt if ided to go ahead with the scheme. whole subject of frequency allo- is so complex, and is subject to ch change from time to time, that sitate to embark on any detailed ion. If anyone is interested in rticular services they are at liberty act the P.M.G.'s Department, who obably be able to help them.

(Kingston, Tasmania) offers some ions regarding the magazine, and we would devote some space to eye" indicator tubes. He also we could suggest a book deal- th all the technical paraphernalia ted with modern record playing cording.

A.: We will keep your suggestions in mind, F.B., in particular the question of an article on indicator tubes, with a view to possible future use in the magazine. Regarding the book, we are afraid we know of no local publication currently available, but we suggest you contact your local bookshops, who may be able to help you further in this matter.

A.D.H. (Dunedin, N.Z). writes to suggest that we publish a summary of specifications with each project, in order to assist readers in their selection and servicing of such equipment. He also inquires about transistor amplifiers for low output pickups, etc.

A.: Many thanks for the suggestion, A.D.H., and we will keep this idea in mind, although there are problems, some of which have been raised in the magazine before. We are keeping our eye on the transistor amplifier idea, but we want to be quite sure that any design we suggest will have a satisfactorily low noise level after allowing for the spread of tolerances in transistors.

B.H. (Lidcombe, N.S.W.) tells us that his radiogram picks up TV programs on about 6 mc. This only occurs when the TV set is switched on, and the channel received changes when the TV is switched over. How is this?

A.: The only explanation we can offer is that the video detector, or the circuitry immediately following it, is radiating enough energy for the radio to pick it up. The sound IF is really 5.5 mc, but the calibration of the receiver could be a little inaccurate. Also the sound channel uses FM, so in order to detect it on an AM radio it is necessary to tune a little off the centre frequency. It is usually very distorted but intelligible.

R.A.C. (Hurstville, N.S.W.) reports great success from the 1 Transistor Set of December, 1958, adding that he can obtain good speaker volume from the set. He asks if a 4-inch speaker will give weaker volume from a certain set than a 6-inch one, all other things being equal.

A.: In general, yes, R.A.C. The smaller speaker would probably be less efficient, and would need more power to produce the same volume.

V.A. (Goulburn, N.S.W.) asks us if we can identify the unlisted component in the "One Transistor Set for Beginners" of February, 1960.

A.: The component which we unfortunately omitted from the parts list of this set is the 4 microfarad electrolytic capacitor used to bypass the emitter swamping resistor. This unit can be a 6 or 12 volt working type (or higher if one is handy) and should be wired so that the positive lead goes to earth. Sorry to have caused you any inconvenience, V.A.

RADIO, TELEVISION AND HOBBIES QUERY SERVICE

To assist our readers, "Radio, Television and Hobbies" conducts a technical query service. Conditions governing this service are set out below:—

(1) Requests for copies of circuits or technical queries requiring an answer through the post must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(2) For the 2/ fee, we will supply circuit data, as available, for up to three projects. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. As a rule, requests for circuits will be answered more speedily if they are clearly identified and not complicated by questions requiring the attention of technical personnel.

(3) The technical query service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits.

(4) The Editor reserves the right to return query fees or to limit the scope of an individual reply, where it is felt that a partial answer will be better than none at all. Please note that the inclusion of an extra fee does NOT entitle correspondents to special consideration.

(5) In addition to the normal query service, chassis blueprints are available for most of our projects, showing the position of all holes and cutouts for metal-working but containing no details of wiring, etc. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in x 8in glossy print; postage 9d extra.

(6) Letters should be addressed to the Technical Editor, "Radio, Television and Hobbies," Box 2728, G.P.O., Sydney.

(7) "Radio, Television and Hobbies" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications of merchandise must be obtained from our advertisers.

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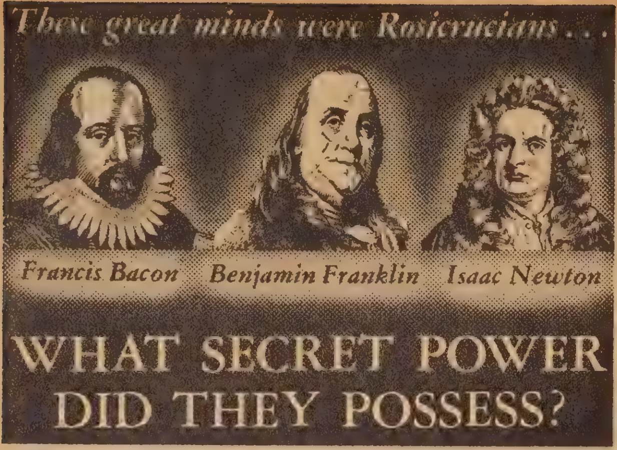
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D OF THE WORLD

(Continued from Page 19)

nsists of a head and tail. The
ontains a nucleus at its centre,
ht point of light. Around the
is the coma.

ng the comet's journey round the
orbits of trillions of miles, the
ollects all kinds of debris from
ist particles to small pieces of
d metal.

head of a comet averages about
miles across, whilst the length of
runs into millions of miles.

idea that great destruction would
in the event of the earth's col-
vith a comet arises from the fact
me people think that the head of
et is a solid body. Now a solid
0,000 miles in diameter would
y bash things about a bit.

ever, a comet is by no means a
dy. Neither is it the airy noth-
ch some people think it is.

SPARENT

debris in a comet's head is so
spaced that the comet as a whole
letely transparent. This is proved
fact that stars on the other side
omet can be seen through the
ith virtually undiminished bril-
The comet is also completely
when it passes between the earth
sun.

ugh the head of a comet is of
all mass, an average of about
lionth that of the earth, it would
bout 6,000 million million tons
wed by 15 noughts). Fortunately
this weight is not concentrated in
place.

s were so, the earth would prob-
ve been smashed to smithereens
o for about five comets come
he earth's distance from the sun
ar. It can be estimated from
t the nucleus of a comet should
with the earth once in every 80
years. Thus, during the 2,000
years of the earth's life, we
ave had about 25 such collisions.
are still here.

PASSAGES

se the head or coma is of such
ameter it is certain that the earth
ed through this layer many times
o must have passed through the
ch is millions of miles long.

is a great crater in Arizona
believed to have been caused
llision with a comet "fragment"
,000 years ago. This crater is
t in diameter and 600 feet deep.
00 million tons of earth was
t by the collision.

ally, if such a comet hit the
some populated spot there would
loss of life and destruction.
, the prospect is rather remote
ld cause no uneasiness in our
view of the odds against it.
us being asphyxiated by some
as in the tail of a comet, this
remote possibility, because of
low density of the comet as a

verage density of a comet as a
only about one millionth that
ir at the surface of the earth.
hough hydrogen, methylene, carbon monoxide and so on have been detected in a comet's tail, the density is so low as to have a negligible effect on even a canary.

The earth has actually passed through the tails of comets on many occasions and no one has been the wiser except those whose business it is to know — and these are not funeral directors or pharmaceutical chemists!

It would seem therefore that we need not fear that we will meet our end during a cometary collision.

Let's see now. What have we left? Oh yes, collision with an asteroid. First of all we will have a look at an asteroid.

These strange bodies are small planets, thousands of them, circling round the sun in the same direction as the planets between the orbits of Mars and Jupiter. They range in size from about 480 miles across down to others about a mile across. There are thought to be thousands more of them no larger than big hunks of rock, too small to be seen in the largest telescope.

Some astronomers believe that there are at least 30,000 of these bodies which can be discovered and a vastly greater number which will never be discovered, unless they happen to pass close to the earth or even collide with it. What are the chances?

PLANETS ASTRAY

Sometimes these little planets go astray a bit and, in doing so, come a little too close to the earth for comfort. The closest approach recorded was in 1937 when Hermes, a mile diameter and weighing about 3,000 million tons, came as close as 485,000 miles travelling at several miles a second. This is only twice the distance of the moon from the earth.

However, because there are very few asteroids whose orbits come within that of the earth, the chance of a collision is extremely remote. In any case, damage would be of a local character and would not encompass the entire earth. The world would not come to an end except for those in the vicinity of the point of collision. For them the end would be swift and certain.

According to the French mathematician Edourard Roche in the year 1850, if a satellite having the same density as a planet came nearer than 2.44 times the planet's radius it would be shattered by tidal forces.

Working this out we find that if the moon came to a distance of about 11,000 miles from the earth it would disrupt. Will this ever occur? Yes, say the astronomers. Sometime.

TOO CLOSE

According to authorities the moon, owing to tidal forces, is gradually moving away from the earth. This will continue until the year AD 50,000 million when the moon will be 340,000 miles from the earth and the day and month will be equal to 47 of our present days.

When this time arrives, some "funny" things will happen. One side of the earth will always face the moon. The effect on the tides will be to have a high tide on the earth under the moon and on the opposite side. As these tides will be stationary, the moon will cease moving away, because there will be no tidal friction.

At this period, because of the influence of tides caused by the sun, the earth's period of rotation will be such that it will be longer than the moon's period of revolution round the earth. This will cause the sun to rise in the west and set in the east taking a few months in the process. We will all get up at night to go to work, and knock off in the morning if you can find out which because of the long day.

The slowing of the earth's rotation to a point lower than that of the moon's revolution will bring the influence of lunar tides into play again in a reverse direction, with the result that the earth will speed up and the moon come within the limits of the earth predicted by Roche's limit, namely 11,000 miles.

At this point the moon will become flattened by the gravitational forces of the earth and will finally break into countless pieces; the earth by the same forces will also be shattered, whilst gigantic tides will rise to tremendous heights, because of the lunar attraction. Those who are not blown up will be drowned so what's the difference?

VIOLENT END?

It would seem therefore that, according to modern theories, the earth and everything on it will some day, millions of years hence, be wiped out by one of several possible methods, mainly connected with the sun and moon.

Nevertheless, we can be comforted in the fact that theories change a lot and no doubt things will not turn out as bad as they seem. The great scientific headway man has made during his infancy may be indicative of a great advance by the year AD 50,000 million, so that he may have found by then some way to counter the forces of nature which will then make everything "unky dory." Unless he blows himself up with atomic energy in the meantime!

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144 Mc. TRANSMIT

(Continued from Page 43)

the 500-volt supply, a second ea
centre tap of the 300-volt supply,
applies 300 volts AC to the ha
rectifier in the negative bias supp
a fourth earths the centre tap
modulator supply (on the mo
chassis) which uses an 83 rectifie

This system allows the mercury
rectifier valves to warm up befo
tension is applied to them. If
lay were not observed, the
could be damaged.

The same relay supply is used
ate an aerial changeover relay
switch off the 144 Mc. converter
means that only one switch need
operated to change all units fro
ceive" to "Transmit" and back
which makes for armchair ope

The transmitter is tested in two
first the exciter by itself, then w
high power final in service. To f
this, a switch may be placed in
modulated 500-volt supply line.

LINING UP

Lining up the exciter follows
the same procedure as that outl
the August issue for the 18½ wat
mitter.

After waiting a few minutes
rectifier heaters to warm, activate
lays to switch on high tension.

With the aid of a grid dip os
or the transistorised wavemeter de
last month, look for output of 24
the slug-tuned coil in the plate
first half of the 12AT7. The slug
be screwed in or out to attain ma
RF output.

Next, measure the RF output f
plate circuit of the second half
valve. The vertically mounted coil
reading very easy. The stage sh
doubling to 48 Mc. Tune the 5
condenser across this coil for ma
drive to the 5763.

The series-tuned coil in the p
the 5763 is a little harder to t
maximum drive to the QQE03/1
put here should be at 144 Mc.
are two adjustments to be made.

The coil inductance is adjus

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ternative re
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models. OV
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zing the turns closer together or ling them further apart. At the time, the 5-50 pF variable capaci- ıust be adjusted to balance the and stray capacitances present in ıpper" section of the circuit. This ıe to ensure that the RF potential h end of the coil will be the same, buting to balanced drive to each QQE03/12 input grids.

degree of coupling between the coil and the grid coils at each end other critical factor. Too tight ng or too loose coupling will "kill" rive. The time taken getting this area functioning properly will be pent.

se remarks apply also to the ad- ent of the plate circuitry of the 3/12 and the grid input circuitry 6/40 above the chassis.

did not provide metering circuitry ıe exciter valves, relying on the storised wavemeter and a coupling o make the various readings.

h the high power final, however, ere generous in our metering. Grid plate dip, and bias voltage are all ntly monitored. Each of these is by-passed for RF.

DRIVE

h the final drawing no plate cur- we were able to tune its grid input ry until the 5mA meter read com- off-scale. You should be able the same.

bias voltage meter is a 2mA nent which is calibrated 0-100 In theory, a 50,000 ohm resistor l make it read 100 volts full-scale ion. Allowing for the internal re- e of the meter, and some variation resistor (snatched from the junk we found a 40,000 ohm resistor ıs the correct reading.

ing obtained ample drive to the and made sure the bias is present, on the high tension to the final. current may swing up to 200mA he tank circuit off resonance. We ed a healthy "dip" at 150 mA the large butterfly P.A. tuning tor was adjusted to bring the cir- resonance.

gging in the antenna — in our the four element beam described r Jeffcoat last month — the 3-50 immer capacitor is next adjusted timum reading.

final output will depend on the ıcy of your antenna and the cor- ıatch at either end of the feedline. oaded up to 200mA, giving us 100 on the air.

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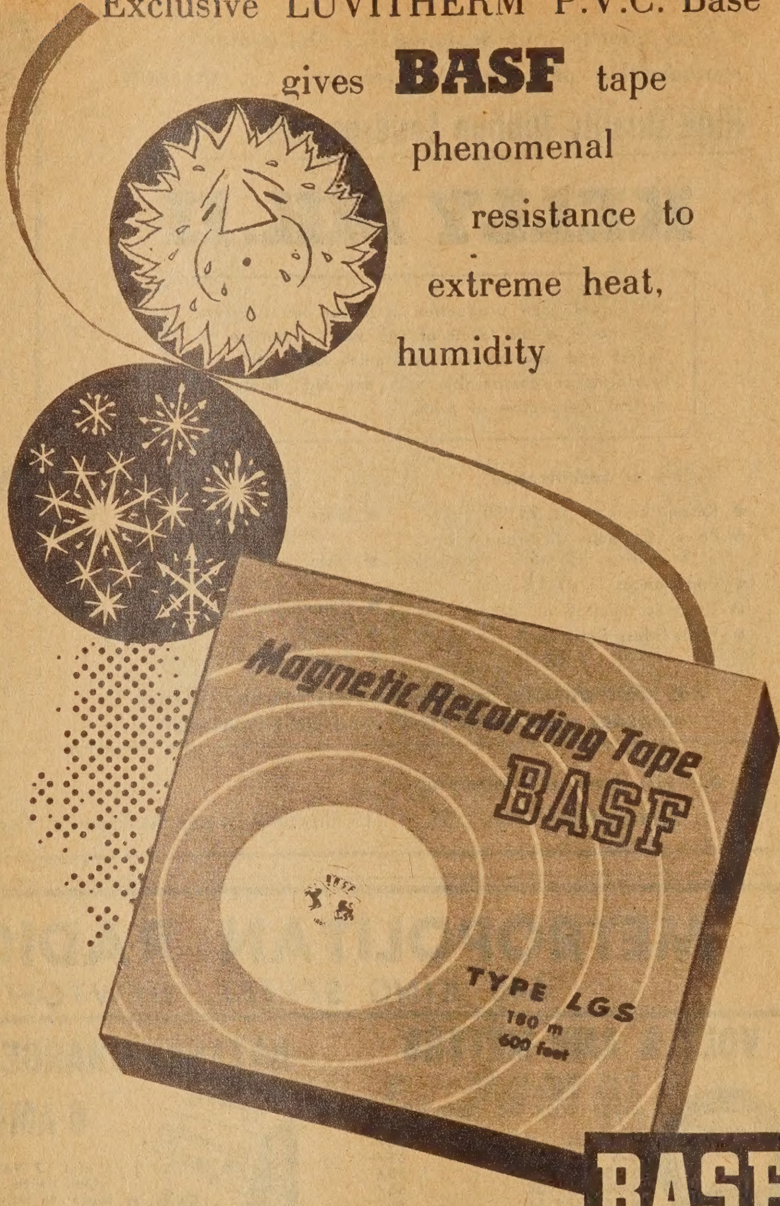

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humidity

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1,200' x 7"	58 3
LONG PLAY—LGS 35	
210' x 3"	15 6
600' x 4¼"	33 0
900' x 5"	44 0
1,200' x 5¾"	56 6
1,800' x 7"	77 3
DOUBLE PLAY—LGS 26	
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1,200' x 5"	3 13 9
1,800' x 5¼"	4 18 6
2,400' x 7"	6 4 0

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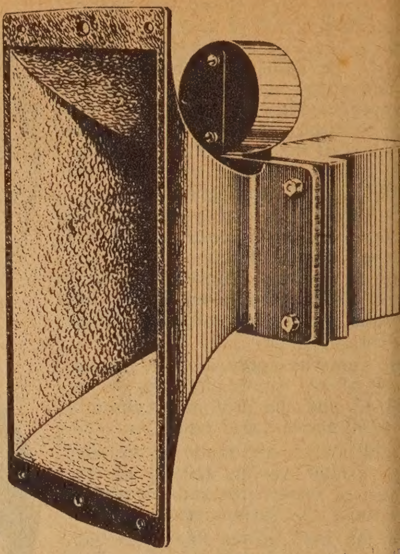

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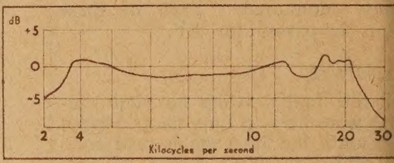
- **Dimensions:** 9½ X 4½ X 7½ inches
- **Weight:** 6lb.
- **Finish:** Silver Grey



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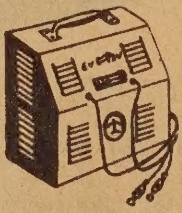
328 MURRAY STREET,
PERTH, W.A.
(Please note however, that prices are necessarily slightly higher in Western Australia).

BATTERY CHARGERS



6 AMP

6 and 12 Volt charger fitted with an ampmeter to show rate and completion of charge. Operates off ordinary household supply.

£13/13/9

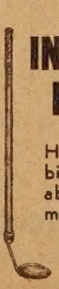
4 AMP

6 and 12 Volt 4 AMP charger, easy to operate from 230 Volt household supply.

£9/12/3

(5/- Delivery to rail for both).

INSPECTION MIRRORS



Handy to all hobbies, a 1in adjustable ball and socket mirror on 8in stem.

10/6
(POST 1/6)

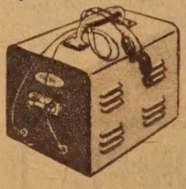
VALVES

EL32	15/-
IK5	3/9
6AG5	3/9
6G6	12/6
7C7	1/6
6SH7	2/3
6SJ7	10/-

832A
Valv
7W7
954
AVII
6R7
217C
6C4

(Post 9d first valve
additional valve.)

TRANSIST
CHECKE



Test NPN and PN
transistors; measur
and Alpha anc
values... .. .. .

£10 (Po

HEADPHONES

Brand new, imported, low impedance headphones suitable for use with recording tape or in mine detecting, etc.

17/6 PAIR
(POST 3/6)

SORR
NO
C·O·

LAR HEATER

ontinued from Page 73)

nd strikes the black collector
ere it is partially absorbed. Heat
ted in the plate as a result of
rption and it is passed to the
oes by conduction through the

will be some losses due to reflec-
he solar radiation both at the
faces and at the plate but they
ively small. When the sun is
he horizon a greater proportion
cident light will tend to "skip"
ass but its intensity will be low
way, compared to that at mid-
we need not worry about it.

a large amount of the light re-
om the plate will be re-reflect-
into the box when it strikes
side of the cover glass. Be-
mat surface is irregular, the
light tends to be scattered in
ions and only a portion of it
h the glass at an angle which
ntly large for it to pass straight

ain overall loss in the system
eat loss from the collector plate
vater pipes rather than from re-
Therefore considerable atten-
be paid to the arrangement of
tion.

viously mentioned, the blacken-
plate, being an efficient absor-
also be an efficient radiator.
, as its temperature rises it will
ce to re-radiate its collected en-
wever, since the operating tem-
of the collector will generally
the range of 100 to 200 de-
he main re-radiation will be in
wavelength regions where the
sses are opaque.

diation from the lower side of
will be slightly less than that
upper surface and it will be
to a large extent by the insu-

ner heat losses will be by con-
nd conduction. Still air is one
ry best of insulators (conduc-
0.000057) and the two layers
e the collector — between the
the first glass sheet and be-
two glass sheets — are very
n this respect. On the underside of the plate we have rockwool, another excellent insulator, which is in fact just a mass of tiny air bubbles held in suspension.

When assembled, the box is fixed in such a position that the maximum amount of solar energy falls on the glass cover and absorber at all times. This poses some small difficulty because the sun's elevation varies considerably throughout the year. However we can choose a compromise elevation for which the overall efficiency is still quite high.

An angle of approximately 39 degrees is recommended for Sydney, and we will publish a list of recommendations for other parts of Australia in the constructional article next month.

Until then, we suggest — if you're interested — that you "survey" your house and surroundings with an eye to likely places for an absorber, keeping in mind the various requirements we have discussed in this article.

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Plus tax £1/13/5

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1	2	3		4	5	6		■	7	8	■	■
9			■	10			■	11			12	13
14							■	■	15			
	■		■	16			17					
	■	18	19					■	■	■	20	
21					■	22		■	23	24		
	■	25			■	26		27	■	28		
	■	29			■	30			■	31		
	■	■		■	■	32			33		■	
34	35	36		37		■		■	38		39	
■	40				■	■		■	41			■
42					■	43						
■	44				■	■	■	■		■		■

ACROSS

1. It improves the selectivity.
7. A little credit.
9. Hurry.
10. Ambition
11. Sudden surge.
14. Democratic figure.
15. Hitchcock film.
16. Right around the edge.
18. High point.
20. The morning.
21. Offshoot.
22. Small company.
23. Native charm.
25. Label.
26. The lot.
28. It's big in London.
29. Distances (abb.).
30. Not positive.
31. Age.
32. Guide.
34. Result.
38. In position.
40. Girl's name.
41. Old convict.
42. Coastal cities.
43. Sporting term.
44. Open network.

DOWN

1. A bridge you should not walk on.
2. Fall ill.
3. Speed.
4. Miscellaneous terminals.
5. Comes up.
6. They live in a new world.
7. Heart of a transformer.
8. Beginning.
12. It's fitted with a diaphragm.
13. Connecting points.
17. Type of booth found in a studio.
19. Carried out on a highway.
24. Peninsular.
27. Solution from ashes.
33. Scientific writer.
35. Preposition.
36. Golf term.
37. Money.
39. Oval bodies.

Last month's solution

M	A	G	N	E	T	O	■	■	D	■	■	■
A	■	H	■	O	■	■	V	■	U	N	I	T
G	R	O	U	N	D	W	A	V	E	■	■	W
N	■	S	■	S	E	A	L	■	S	T	Y	E
E	T	T	E	■	B	I	E	R	■	O	■	E
T	E	S	T	P	A	T	T	E	R	N	■	T
R	T	■	H	I	T	■	■	T	H	E	M	E
O	R	D	I	N	A	T	E	■	U	■	■	R
N	O	■	C	■	B	E	L	L	B	O	Y	S
■	D	I	S	P	L	A	Y	■	A	B	O	■
■	E	■	■	O	E	R	■	P	R	E	Y	S
U	S	H	E	R	■	S	L	A	B	■	O	■
■	■	■	■	T	■	■	■	R	■	U	S	A

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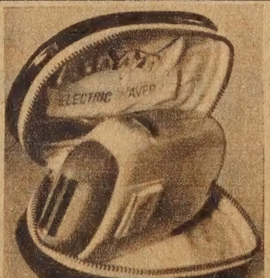

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or offer. Write **P. Van Dyken, Terr**

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able offer. **Box 196, Traralgon, V**

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anteed as new. Any demonstration
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